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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

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Index to Advertisers and Classified Index Following Reading Matter.

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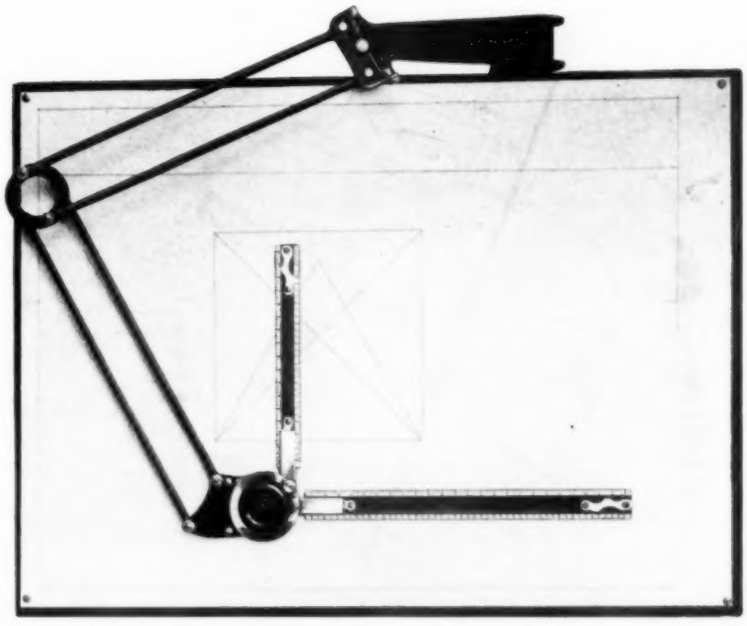

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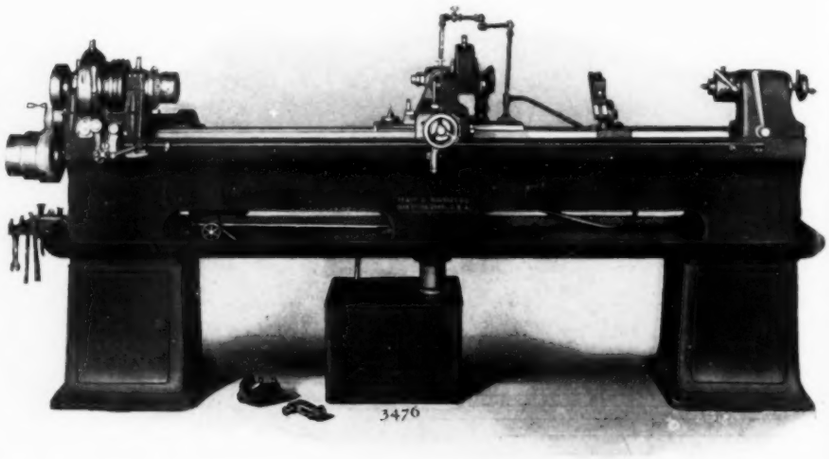

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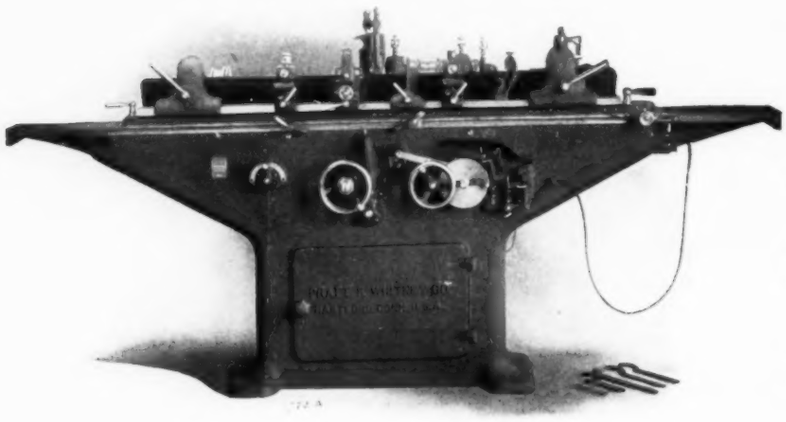

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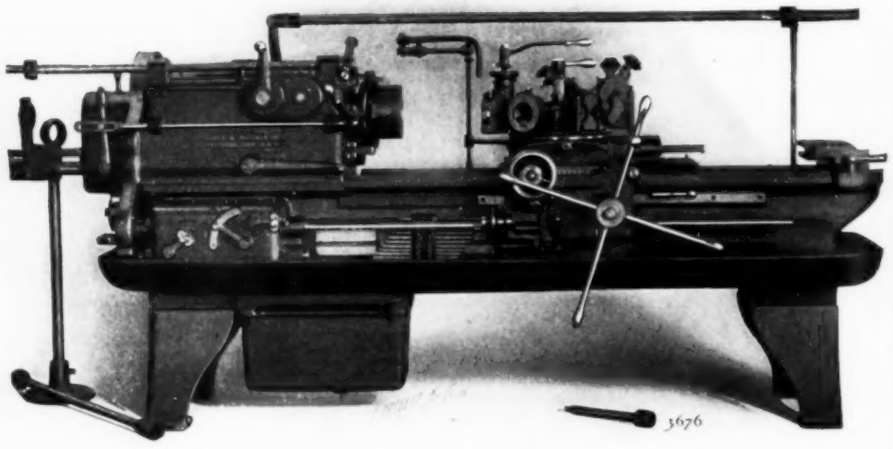

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Metallic Shop and Store Room Furniture

Showing a Very Encouraging Line of Progress in the Substitution of Fire proof for the Highly Inflammable Constructions of Wood

EDITORIAL CORRESPONDENCE

The substitution of metallic and other fireproof constructions for those of wood is proceeding at a rate which few appreciate. Frame dwellings and other buildings which are so characteristic of American landscapes and locations other than those in the larger cities, are a feature which is almost unknown elsewhere, and under the spur of the rising price of timber an amount of attention is now being given to the development of fireproof constructions which, we are informed by architects, has already brought the cost of country dwellings of this character down to almost that of the customary construction of wood.

One of the most recent fields of the carpenter to be invaded by fireproof construction is that of shop and storeroom furniture, and there is no field in which it is more appropriate. The cellular character of these fixtures, combined with the fact that they soon become soaked with oil when of wood, makes them highly inflammable and a serious fire risk.

FIG. 3. SHELVES AND DRAWERS FOR THE TOOL OR STOCK ROOM

Progress of the Movement

We have become increasingly aware of this movement by the constructions which we have seen when visiting various shops, but we must confess that we had not in this way formed an adequate idea of the extent to which the manufacture of this equipment has been developed. The idea of preparing this article was the outgrowth of the furniture which we have seen in use, but on setting out to gather material

FIG. 1. ADJUSTABLE SHELVING

FIG. 2. OPEN-END SHELVING

to illustrate what is being done, we were overwhelmed with it to the extent that we are embarrassed in making the selections.

The photographs from which the half-tones have been made were supplied partly through the courtesy of the shops where the fixtures were found and partly by the manufacturers of the devices shown. The selections cover the work of several manufacturers, although in no case is the complete line of any one manufacturer shown, the idea being rather to show the variety of purposes to which fireproof construction has been applied, and some of the different constructions used for the same purposes, rather than to illustrate any one maker's complete line. The reader will, therefore, understand that while this article gives a somewhat large idea of the extent to which this movement has gone, this idea is, nevertheless, not large enough, since many of the devices shown could be duplicated several times were we to show variations in minor details.

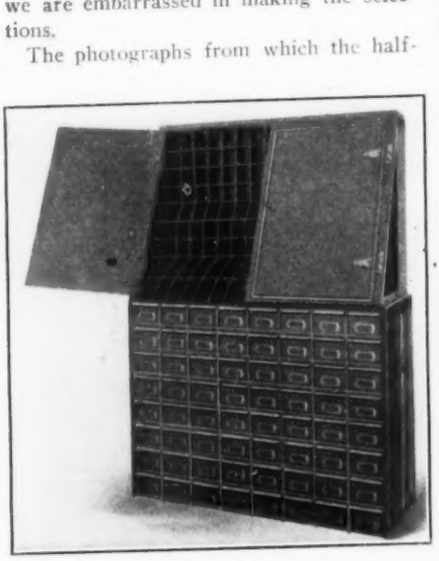


FIG. 5. CABINET FOR FILES, SCREWS, ETC.

Shelving and Cases of Drawers

Taking up first the case of simple shelving, we have an example by the Van Dorn Iron Works Company, of Cleveland, Ohio, in Fig. 1. The construction almost speaks for itself, although the turning down of the fronts and the turning up of the backs

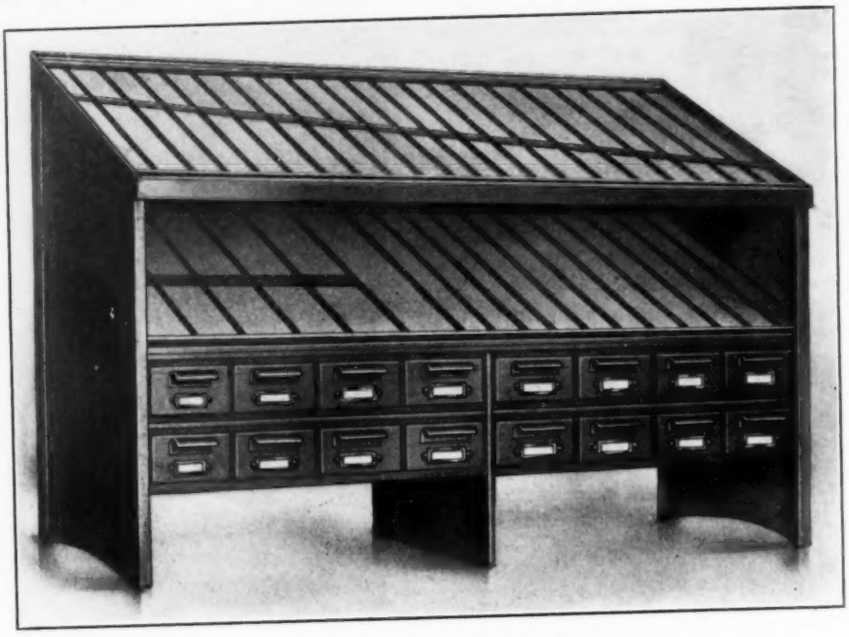


FIG. 6. RACK FOR TAPS, REAMERS, ETC.

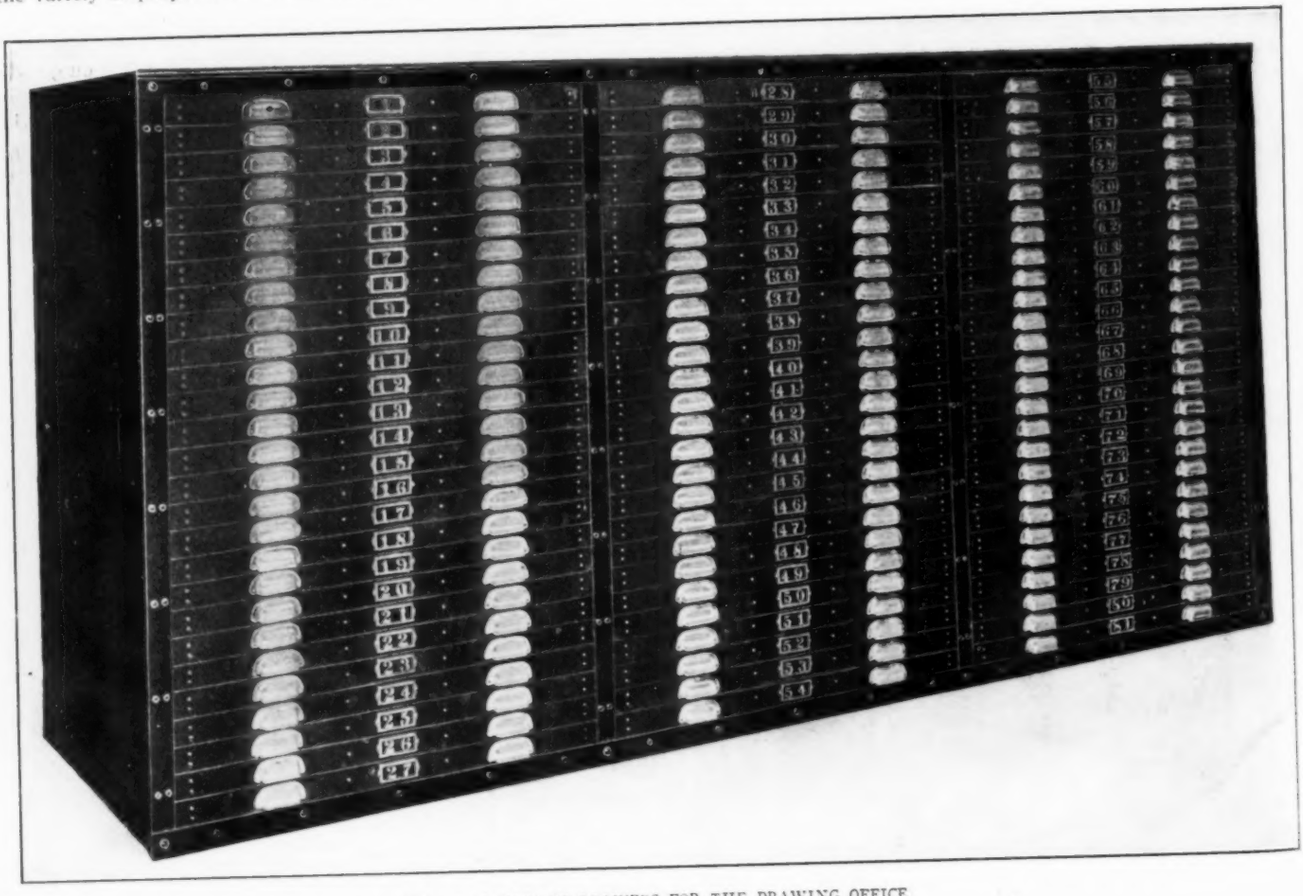


FIG. 4. A CASE OF DRAWERS FOR THE DRAWING OFFICE

of the shelves, whereby stiffness as well as the necessary back is provided, should be noted. This illustration shows also a feature which is characteristic of many of the constructions wherein these fixtures are superior to those of wood, namely, their adjustability. The series of holes by which the shelves are attached to the uprights, and whereby a variation of the spacing of the shelves becomes the simplest matter, is apparent. The advantage of this adjustable feature is more apparent in structures of greater complexity, such as racks and bins, wooden structures of this character being very awkward to change if change is needed.

From shelving of the character shown in Fig. 1 to the open construction shown in Fig. 2 and to those shown in Figs. 3 and 4, all of which are by the Cleveland Wire Spring Company, is an easy step. Of these Fig. 3 is intended for the tool or stockroom, while Fig. 4 is intended for drawings and blueprints.

Cabinets and Racks

Two other constructions for the tool room by the Lyon Metallic Manufacturing Company, of Aurora, Ill., are shown in Figs. 5 and 6, the former being intended more especially as a file or screw cabinet, and the latter as a rack for taps, reamers, and other tools. This company has a number of other interesting constructions, from among which we select Fig. 7, which shows a rack intended for use by brass foundries for holding patterns fitted to match boards.

FIG. 7. RACK FOR BRASS FOUNDRIES

Other constructions of plain shelving by the Manufacturing Equipment & Engineering Company of Boston are shown in Figs. 8 and 9. From cases fitted with drawers to those intended for tote boxes is another easy step, and such a case by the same manufacturers is shown in Fig. 10. Fig. 11 shows an adjustable system of shelving by Merritt & Co., of Philadelphia

FIG. 8

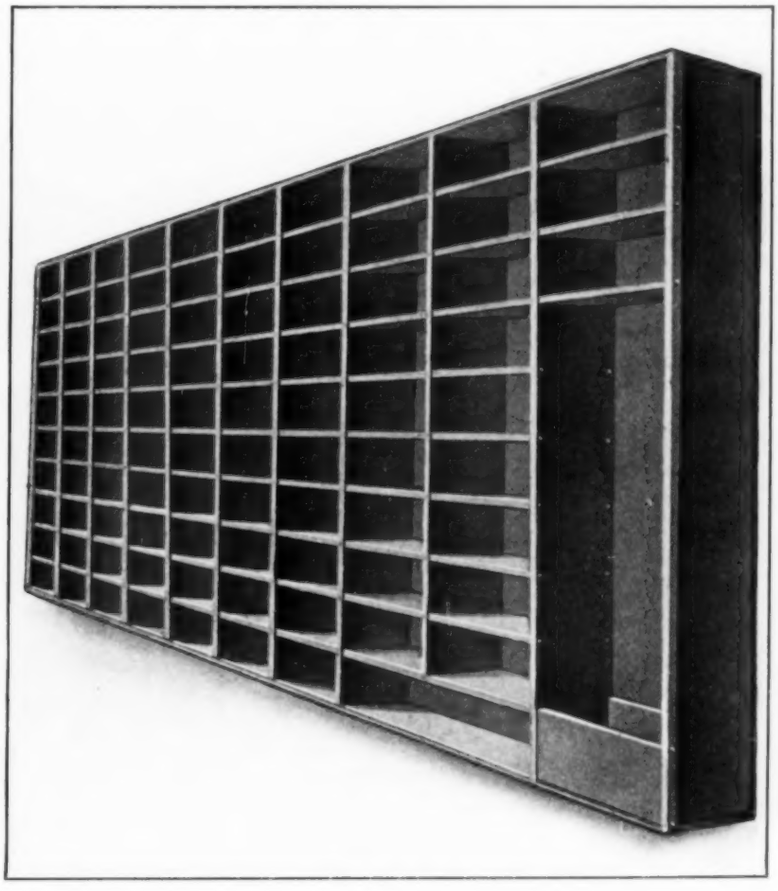


FIG. 9

ADDITIONAL EXAMPLES OF SHELVING

which is hand adjustable and may be set up or taken down without the use of tools. Figs. 8, 9 and 10 are not apparently adjustable, although, of course, there is no difficulty in so making them. Fig. 12 shows a unique construction of stamped spiral stairs by Merritt & Co.

Work Benches, Drawers and Desks

Fig. 13 shows a complete metallic workbench with metallic drawers, and Fig. 14

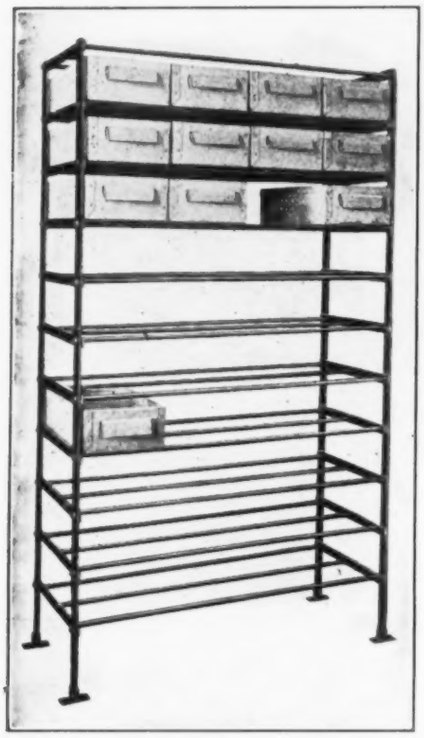


FIG. 10. A RACK FOR TOTE BOXES

shows a metallic drawer intended to be placed below a wood bench of the usual construction, both by the New Britain Machine Company, New Britain, Conn. The bench is intended more especially for handling hot work and for laying-out purposes, as the manufacturers believe that benches with wood tops will not be superseded for general purposes by those of metal. The front, bottom and back of the drawers are lined with wood, as these are the surfaces against which edged tools are

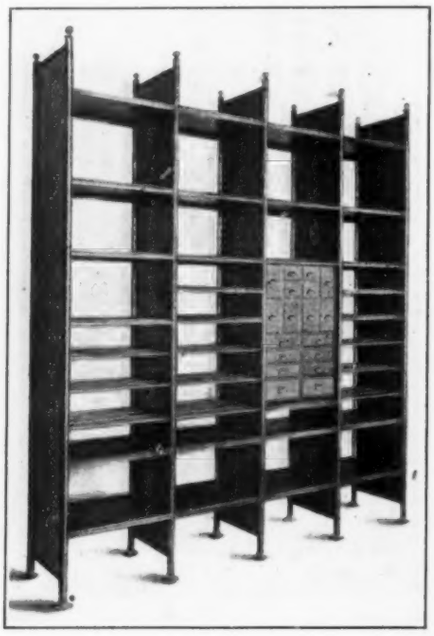


FIG. 11. ADJUSTABLE SHELVING REQUIRING NO TOOLS FOR ERECTION

apt to come in contact, and which are of wood to prevent possible damage. The shelf is mounted on roller bearings, with racks and pinions connected by a shaft in order to insure that the drawer shall pull out squarely and make cramping impossible. This provision, with the roller bearings insures a smooth action with no shucking of the contents.

The next four pictures have been supplied by the courtesy of the Burroughs Adding Machine Company and show constructions partly of their own make. Fig. 15 is a rack for tote boxes, the boxes having been bought and the rack made at home. The rack is of a different construction from any previously shown, and the holes in the uprights show how the spaces may be adjusted to the different sizes of boxes. Fig. 16 shows the interior of the room in which finished parts are washed in gasolene to remove the oil. The floor is of cement and every piece of furniture in the room of metal. The benches and tote boxes were made by the Lyon Metallic Manufacturing Company. Fig. 17 shows a foreman's homemade metallic desk, with a metallic stool by the Toledo Metal Furniture Company beside it.

As a further illustration of these devices in use, we include in Fig. 18 a picture of a

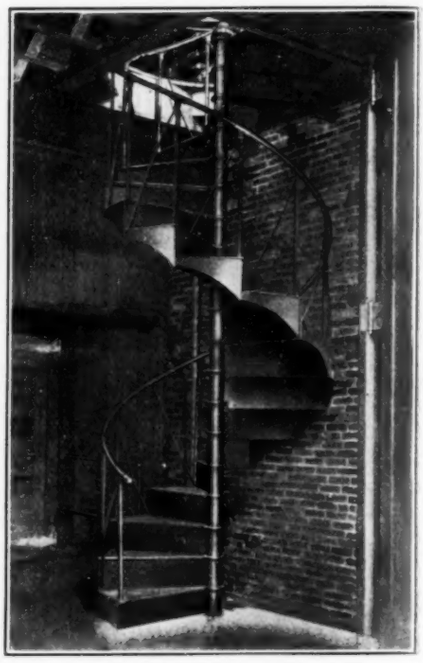


FIG. 12. STAMPED STEEL SPIRAL STAIRS

stock room supplied by the Lucas Machine Tool Company, for which the cases were supplied by the Van Dorn Iron Works Company. The steel shelf boxes shown most distinctly at the left of the picture are of the same size as those used in the shop for work in progress—an arrangement by which the boxes can be stored in

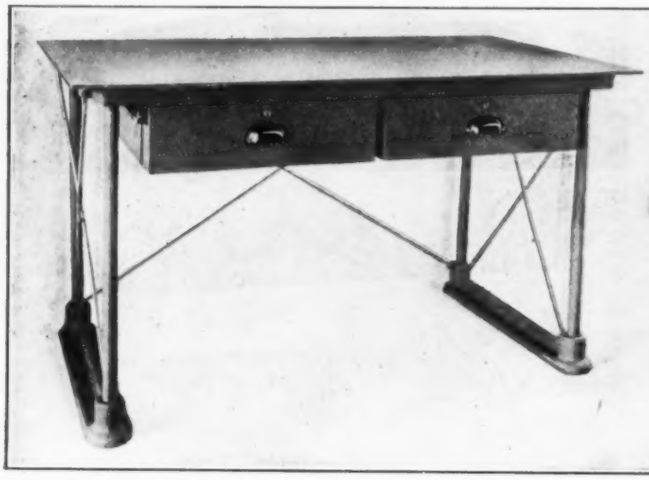


FIG. 13. METALLIC WORK BENCH

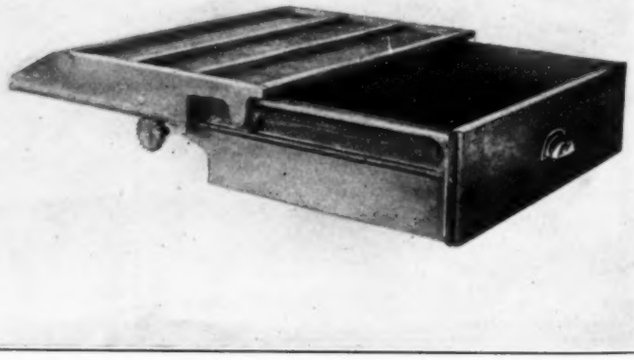


FIG. 14. WOOD LINED METALLIC DRAWER

FIG. 15. ADJUSTABLE RACK FOR TOTE BOXES

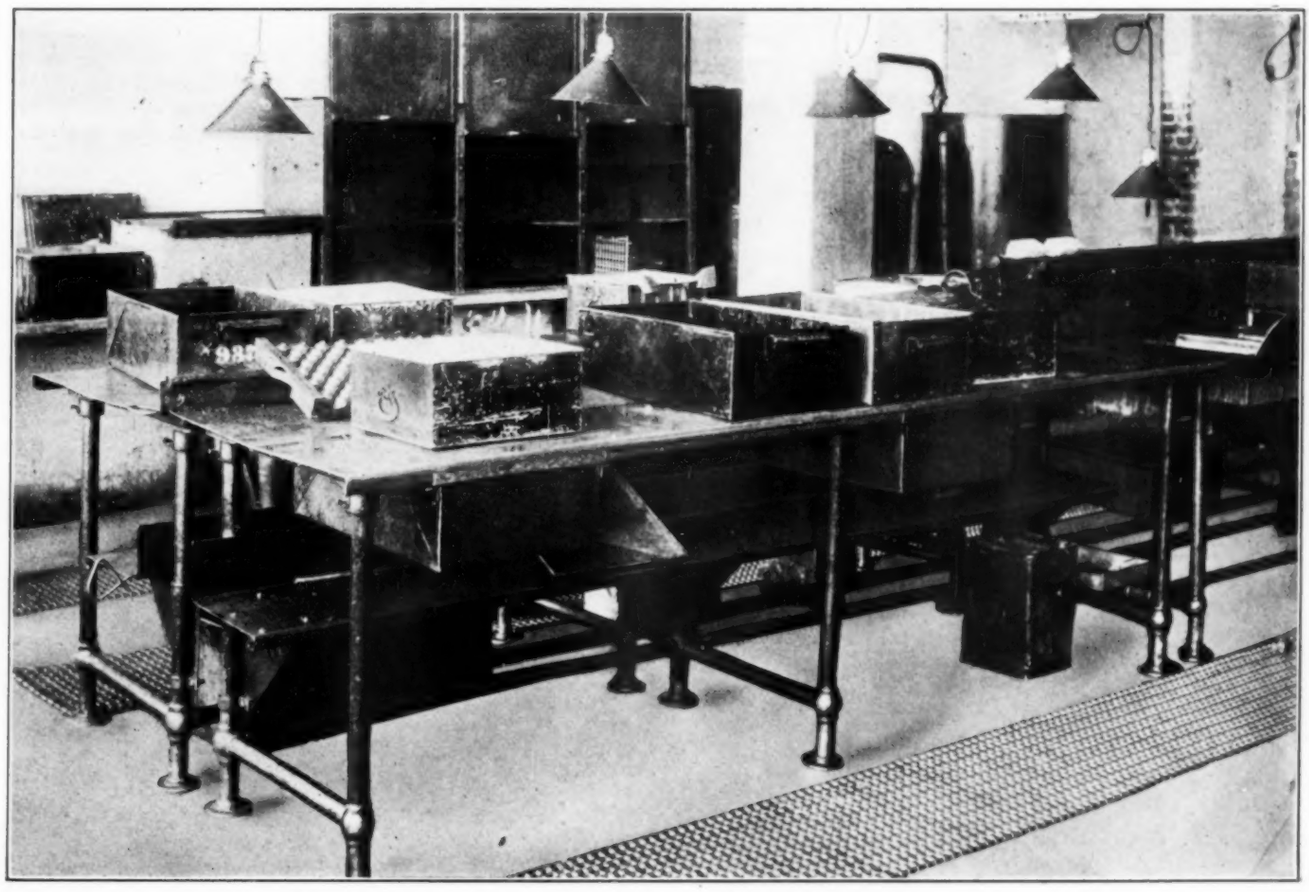


FIG. 16. A ROOM FOR WASHING PARTS IN GASOLENE

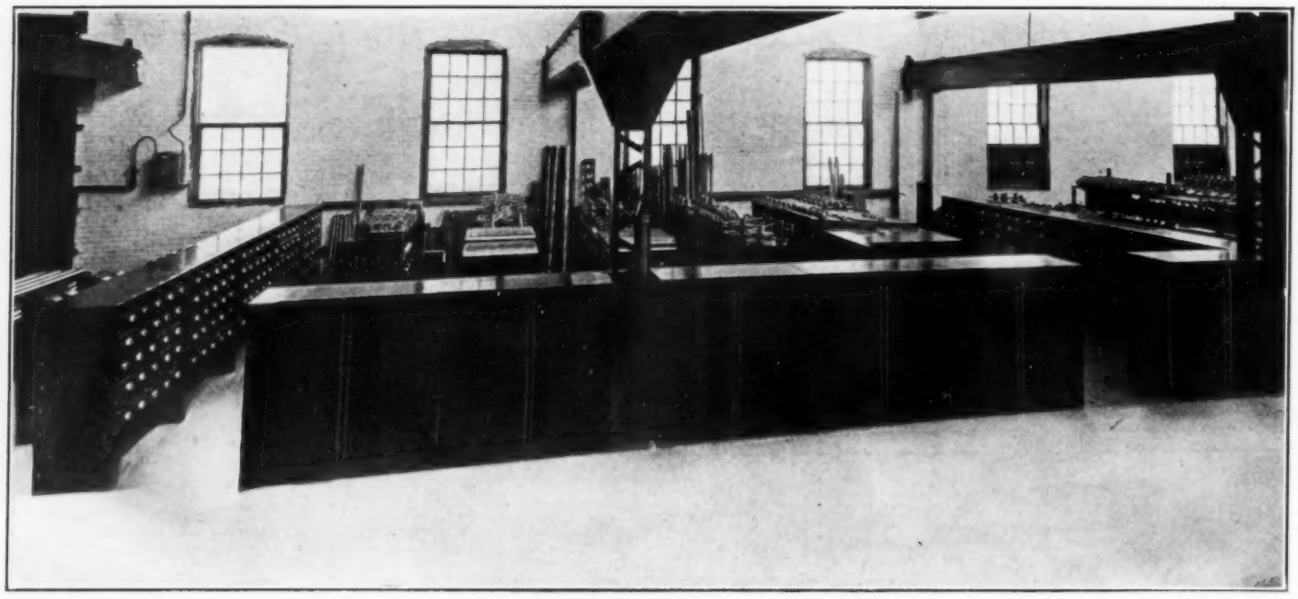


FIG. 18. A METALLIC STORE ROOM

place without transferring the contents when the parts reach the store room. In the background, fastened to the brick wall, are shown vertical racks for long pieces, these racks being made of castings, into which are screwed ¾-inch rods, those seen in the picture being 12 inches long, while nearer the floor is a similar arrangement in which the rods are 15 inches long to provide for the inclination of the pieces.

Heavy Racks for Bar Stock and Tote Boxes

Fig. 19 shows a rack for bar stock for which the photograph, together with the three that follow it was supplied by the Electric Controller & Mfg. Company, of Cleveland, O., the racks shown in Fig. 19 having been obtained from the Warner & Swasey Company. This form of rack is by no means new, but we never see it without wondering why anyone should make racks of the usual form after seeing one of these, and it is worth showing even if some of our readers have seen it before. Fig. 20 shows another form of rack for bar stock, which was homemade. Inspection of the picture will show how by turning the arms around, large spaces are provided at the bottom for heavy bars and smaller spaces at the top for lighter stock. Fig. 21 shows a heavy rack for

FIG. 17. FOREMAN'S DESK AND STOOL

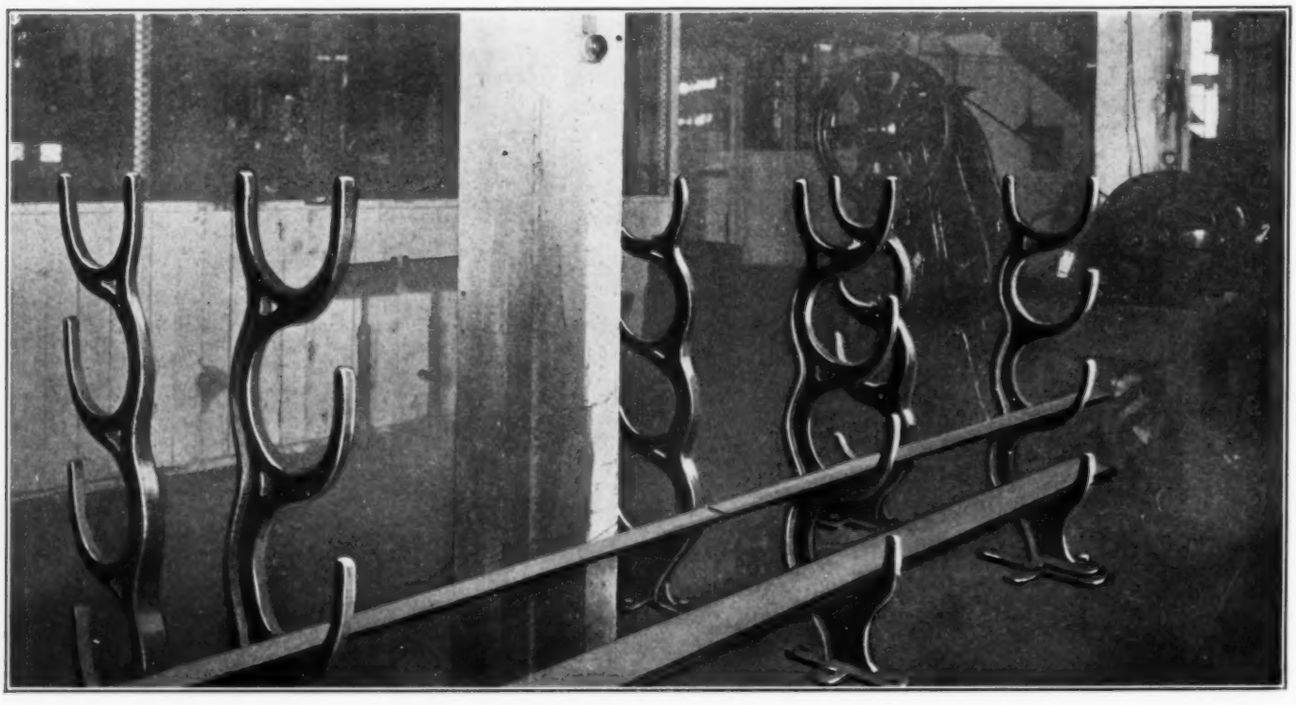


FIG. 19. RACKS FOR BAR STOCK

tote boxes of various sizes. This rack was made by the Cleveland Wire Spring Company. Inspection of the picture will show the provision for adjusting the slides to accommodate boxes of different sizes, while the great strength of the construction is obvious at a glance. Fig. 22 shows a rack from the same place, which was homemade to accommodate tote boxes of a type already in use. This rack is not adjustable, though it could be easily so made if desired. Other forms of heavy bins and shelving by the Lyon Metallic Manufacturing Company are shown in Figs. 23 and 24.

Fig 25 shows a steel barrel with trunnions and a steel truck fitted for it, the whole by the Cleveland Wire Spring Company. The layout of the truck is such that with the handles depressed to the floor the trunnions are behind the wheels, in which position the barrel may be dumped by one man when fully loaded.

According to Doctor Grossman in an interesting paper on the subject, boiler plate will not suffer from corrosion if magnesian waters or carbonate of lime be present. But if an inefficient softening process has first been carried out corrosion is intensified.

FIG. 21. ADJUSTABLE HEAVY RACK FOR TOTE BOXES

FIG. 20. ADJUSTABLE RACK FOR BAR STOCK

Heat Treatment of Carbon Steel

By J. H. Gill

Several articles have appeared recently on the working of carbon steel that, it seems to me, fail to bring out the most important points in the heat-treatment of carbon steels.

Carbon steel will stand a pretty good heat if properly treated afterward. For instance the forging may be done at a bright red heat, and usually it is safe to forge steel at a heat that will raise a good scale. Steel should be tempered at the lowest heat that will give the thorough hardening, and this is a much lower heat than that which may be used to forge a tool.

The important point is how this hardening heat is secured, and the following experiment will bring out the point better than a lot of words: Take two pieces of steel from the same bar and number them 1 and 2. Heat No. 1 to a good full red, forge to the desired shape, and lay it where it may cool slowly. Heat No. 2 to the same heat and forge, as nearly as possible, in the same way. After forging let it cool down to the proper hardening heat and then dip it in the hardening bath. Then take No. 1, that by this time is not more than black hot, and heat it very carefully to the same heat that was used

FIG. 22. ANOTHER RACK FOR TOTE BOXES

FIG. 23. HEAVY BINS AND TOTE BOX RACK

to harden No. 2, and dip it in the same bath in the same way.

Ascending and Descending Heat

This gives us two pieces of steel that have been forged at the same temperature and hardened at the same temperature. Now break off a corner of each piece and notice the grain in the steel. No. 1 will have a fine grain and show the desirable hardness and strength, and No. 2 will show a coarse, glistening fracture that indicates overheating. The difference, of course, is caused by the heat-treatment. No. 1 was forged, then cooled to a black heat and hardened on the *ascending* heat, while No. 2 was hardened at the same heat, but on the *descending* heat.

This point is overlooked by so many toolsmiths. They put a tool in the fire, heat it for forging and work it to shape. Then, as it cools down, they watch for the proper heat for hardening and dip the tool. They get, as a result, nearly the same grain that they would if they had hardened the tool at the highest heat that the steel had had during the process. In cooling and then reheating to the proper hardening heat, and not above it, the coarse grain is avoided and the tool is in good shape to do its work. If in heating to harden, any part of the tool gets a little too hot the tool should be put to one side till cool and then reheated with more care and hardened at the lowest heat that will harden it thoroughly. If one corner gets too hot, this corner will have the grain that corresponds to that high heat, even if the tool is taken from the furnace and the heat is equalized before the tool is hardened.

Proper Heat for Hardening

Another point that is important is to have a good deep, well coked fire. The blast must not strike the steel till it has passed through a good bed of incandescent coke and the metal should be heated evenly and thoroughly. More steel is injured by an uneven heat than by too high a heat. It must be hardened at the proper heat and always on the rising heat.

FIG. 25. STEEL BARREL AND TRUCK

Different carbon steels harden at different temperatures which depend on the carbon content. The higher the carbon is in the steel the more sensitive that steel is to heat and the lower should be the hardening heat. We are told to harden at the lowest possible heat, at the point of recalescence, at the point where the carbon changes from the nonhardening to the hardening form, etc. The trouble is to find this point for the many grades of steel that we are called on to harden. We are often given the finished tool and have no knowledge of the steel.

Obtaining the Proper Hardening Heat

There are several ways to tell the proper heat. One is to heat it to a low heat and quench it in the hardening bath, then try it with a sharp, fine cut file. If not hard, heat a little hotter, quench again and test. In this way, the proper heat may be found, but this method is not always feasible.

Another way depends on the fact that steel loses its magnetic properties at the same temperature that the carbon changes form, and this is at the point of recalescence. A piece of carbon steel will have an attraction for a magnetic needle till it is heated to a certain temperature,

FIG. 24. A LARGE EQUIPMENT OF BINS AND RACKS

which depends on the carbon content of the steel. At this temperature there is no more attraction than for a piece of brass or lead. As the steel cools past this point, the attraction returns. There is one trouble with this method of determining the hardening point of steel and that is that unless the piece of steel is heated all over to the hardening point, the part that is not hot will affect the needle. Even if the piece of steel is heated all over the tongs used to handle the piece may affect the needle. An ordinary bar or horseshoe magnet may be used to test the steel instead of the magnetic needle. It is not as sensitive as the needle, but the cooler parts of the steel or the tongs will not be as apt to mislead the operator.

Application of Above Method

If we have a milling cutter to harden and do not even know the quality of the steel, we need not have any trouble if we use the magnet to get the recalescent point. One way of doing this is to place the cutter in the furnace or fire and heat it carefully, then as soon as the dark red shows take it out and place it in the plane of the magnetic needle or in contact with the bar magnet. If there is an attraction observed the steel is not hot enough. Raise the heat a little higher and test again in the same way. Repeat this till there is no attraction observed. If the heat is then uniform throughout the piece, it is in the best condition for hardening. It takes so little time to use this method that it should be of great service in hardening tools from different kinds of carbon steel. If a large number of tools of the same steel are to be hardened it is only necessary to test one occasionally to be sure that the proper heat is kept in mind.

The article by George T. Coles on page 366 of the American Machinist is interesting. The reheating of the burned steel and cooling in linseed oil has somewhat the same effect as working under a heavy hammer, except that it does not distort the piece. If the tool is of such a shape that it is liable to crack the quenching in oil will leave it in a strained condition that may cause a crack when the tool is hardened. If this strained condition is relieved by annealing, the tool can be hardened without as much danger of cracking.

Multiple Drilling Heads in Automobile Work

The use of multiple drilling heads has usually been confined to small holes but the Langelier Manufacturing Company, of Providence, R. I., has recently built several heads for automobile work which handle good sized drills over a considerable area.

Figs. 1 and 2 show two of the drilling heads which give something of an idea as to the spacing of the drills and also that it is not necessary to have them all of the same length.

Figs. 3 and 4 show two of the drill layouts, which almost explain themselves, the first being for drilling the holes in the cylinder cover and the magnet support for a well-known automobile engine. Fig. 4 is a combination of 12 spindles divided into two different groups as designated by the letters *A* and *B*. This is a combination head for drilling the holes in two separate pieces of work, one piece requiring the *A* spindles and the other those marked *B*. By combining them in this way the cost of the drilling head was lower than as though it had been necessary to make two separate heads. Both of these heads were attached to medium size upright drilling presses, that class of machines in which the feed is accomplished by moving the saddle with the spindle, instead of the spindle only, as in the majority of machines.

But these are small as compared with a head for drilling the oil pan and crank case of a four-cylinder engine at one setting, 74 holes in all, the smallest ⅜ inch and the largest for a ½-inch gas-pipe tap. The extreme center distances are 12½ inches one way by 31 inches the other.

Two main spindles were required in this case to drive the 74 drilling spindles, the type of machine used, being a standard arch-bar drill such as is used in railroad work. As the drill-cutting thrust is excessive in a head of this size, the feed was accomplished by raising the table, it being powerfully geared and actuated by the machine itself. A feed knock-out was also provided. These multiple drilling heads can be attached to almost any of the standard drilling presses, slight alterations only being necessary on main spindle and saddles.

FIG. 3

CYLINDER HEAD DRILLS

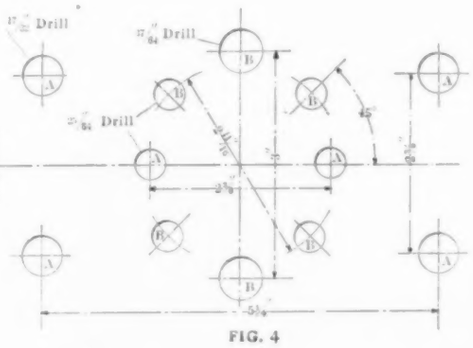


FIG. 4

CRANK-CASE DRILL HEAD

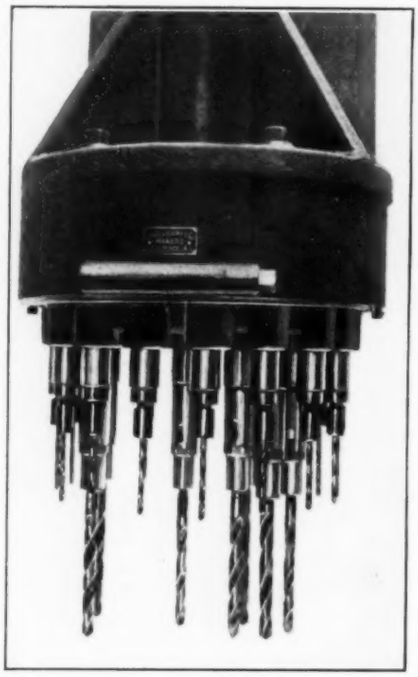


FIG. 1

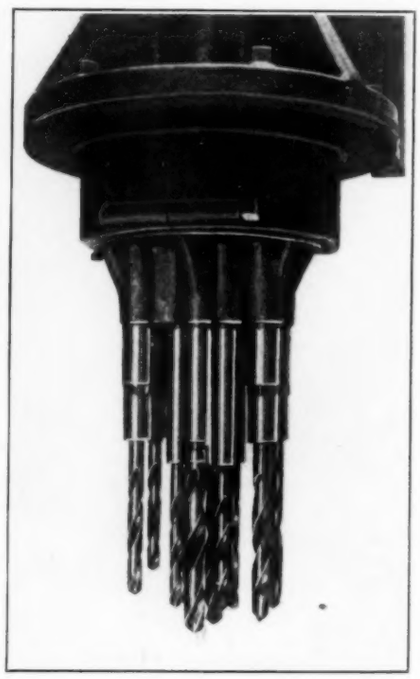


FIG. 2

MULTIPLE DRILL HEADS FOR AUTOMOBILE WORK

Tool Room Methods in a Typewriter Factory

The Equipment Includes a Jig Boring Machine and Special Grinding and Relieving Apparatus for Cutters, Counterbores and Other Tools

BY F. A. STANLEY

In the tool room of the Underwood Typewriter Company, at Hartford, Conn., there are a number of special machines which have been built for facilitating the construction and maintenance of jigs, fixtures and other special tools employed in the manufacture of the typewriter. Several of these machines are illustrated in the accompanying half-tone and line engravings.

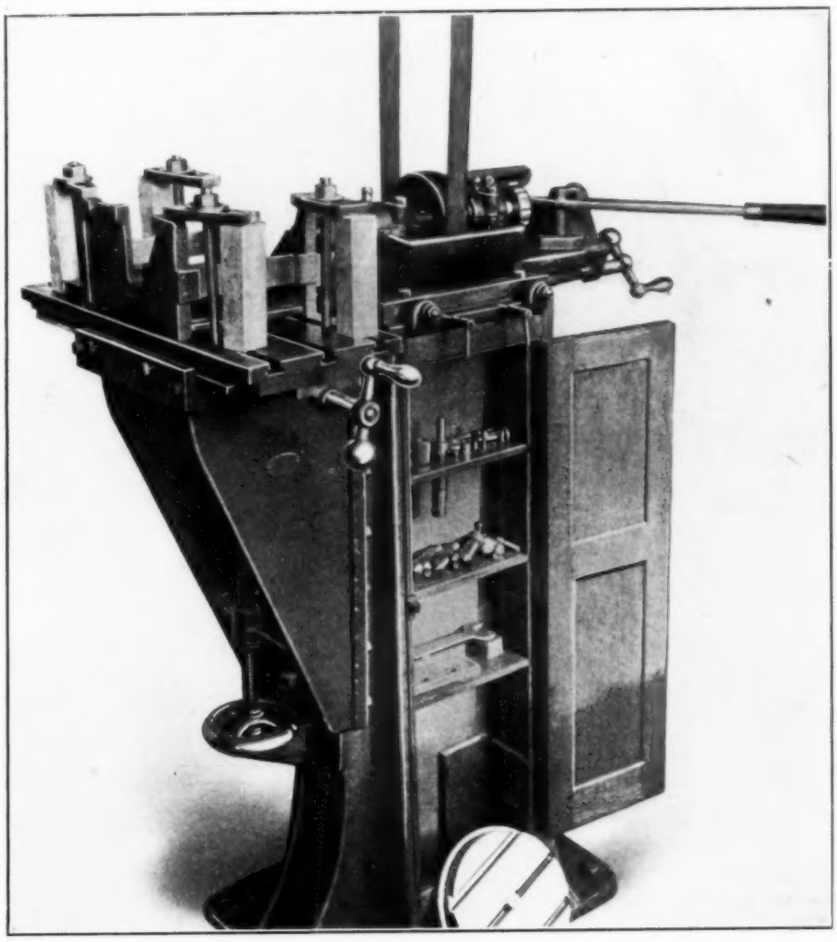


FIG. 1. JIG-BORING MACHINE

A Jig-boring Machine

The machine in Figs. 1 and 2 is a jig-boring tool in which all settings of knee and table are accomplished by size blocks, complete sets of which are always available at the Underwood tool room. These blocks are used not only in connection with this boring machine, but also for laying out dies and similar tools and for various other purposes. They are conveniently arranged in separate compartments formed in wooden cases and range in sizes by thousandths from 0.025 to 0.125 inch and in thirty-seconds from 1/32 to 1 inch.

Upon referring to Fig. 2, it will be seen that the machine is fitted at *A* and *B* with a pair of hardened plugs, while similar plugs are located at *C* and *D*, under the table. The vertical adjustment of the knee and table is accomplished by operating the elevating screw by means of the hand wheel, and the required setting is obtained positively by placing a size block of the necessary thickness between the plugs *A* and *B*. The former is fixed in a seat in a lug projecting from the column face and will be noticed just to the rear of the elevating hand wheel in Fig. 1. The plug *B* in the knee is directly in line with *A* and the faces of the two are exactly parallel with each other. The longitudinal settings of the table are obtained by using the necessary size blocks between plugs *C* and *D*, which are fixed respectively in the side of the knee and in a projection depending from the end of the table. Thus, the vertical and horizontal movements of the table required to adjust the work for the different holes which are to be bored, are readily secured by using side blocks representing the distances from center to center of the holes.

Ball-bearing Head

No provision is made for in-and-out movement of the table, the boring operations being performed by feeding the spindle head longitudinally in its guide. For this head movement both screw and direct hand-lever feeds are provided, as indicated in Fig. 1, although, in the drawing, Fig. 2, the crank handle for the screw is not shown. The boring head is very sensitive in its action and no matter how small the hole may be which is being bored, the cut of the tool may be felt by the operator all through the operation. This delicacy of action is made possible by the fact that the head is carried on ball bearings which permit it to float freely back and forth in its guide although at the same time all side play is positively avoided.

The ball guides or races for the head will be seen at *E E* in the front elevation, Fig. 2, and details are given in Fig. 3. The races are provided with tool-steel liners, which are hardened and pressed into place in the machine-steel strips and afterward ground. The two outer races are cut away at the center, as shown at *F*, Fig. 3, and pins are driven in at each end of the race proper to confine the balls, of which two are used at each side of the head. These will be noticed at *G G* in the side elevation in Fig. 2.

Boring Tools

The spindle is provided with ball-thrust bearing and is bored to receive draw-in collets. Ordinarily, in this tool room, the holes in a jig are bored out to size after running a drill through, without making use of a reamer. A single-pointed tool is used and this is constructed so as to be readily adjusted to permit the hole to be bored true to size. The sketch, Fig. 4, shows the principal features of the boring tool commonly used in the machine.

The holder *H* for the boring tool is screwed into the plate *J*, which is attached to the body *K* by a shoulder screw *L* and adjusted by opposing screws *M N* to set the tool to the cut, the ends of these

screws abutting against extension *O* at the inner end of *H*. The holder *K* is in the form of a blank collet drawn into the spindle in the usual manner. Screw *P* tapped into its face acts as a clamping screw for plate *J* after the latter has been adjusted, as required by screws *M* and *N*. Boring tools of the general form indicated at *Q* are made with bodies of uniform size to fit holder *H* and with various sizes of cutting points to suit different diameters of holes.

There are, of course, a number of attachments used with this boring machine for certain classes of work; among them knees and angles which are slotted to permit work to be conveniently bolted to their faces, and a circular plate or table which is graduated to allow the job attached thereto to be set around to any desired angle with the boring spindle. This latter attachment is shown in Fig. 1, near the base of the machine. A number of chucks, plugs, boring tools and other appliances will also be noticed on the shelves of the cabinet formed inside the column.

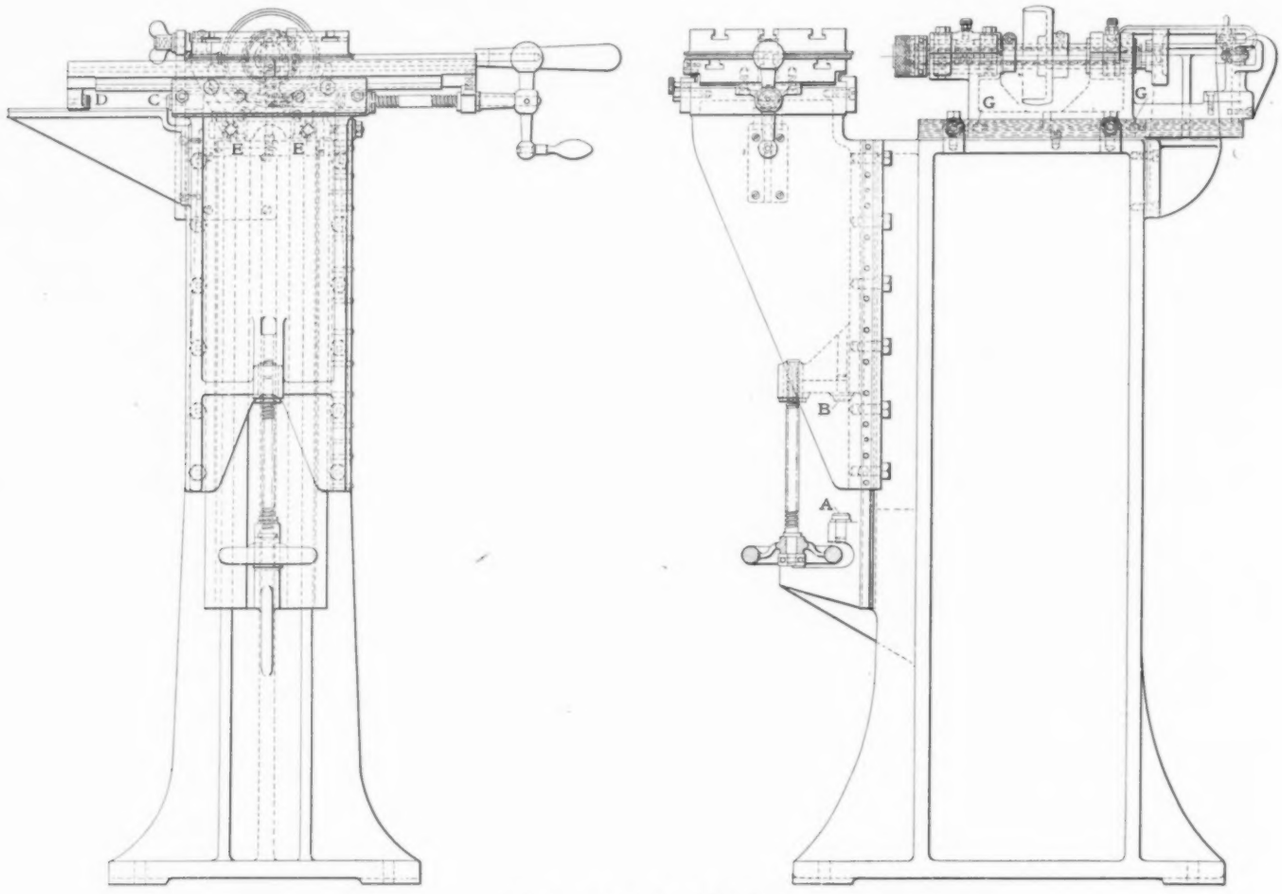


FIG. 2. JIG-BORING MACHINE

Attachment for Surface Grinder

In Fig. 5 is illustrated a high-speed attachment for a surface grinder which is very convenient for grinding out small openings, seats in jigs and other work which is so located or of such a form as to make it impossible to use the regular type of wheel. The attachment is used as a Brown & Sharpe surface grinder and is applied by removing the regular grinding wheel from its spindle and slipping the head *A* on the bearing through which the spindle projects. Pulley *B* is then put on the spindle in place of the wheel, and the attachment is swung around to the desired position and clamped by the binding screw at *C*. Driving pulley *B* and the wheel spindle pulley have two steps and the spindle when running at its highest velocity has a speed of 14,000 revolutions per minute. The jig shown is held by the magnetic chuck and although the wheel is operated in a restricted space the seat which is being ground, will of course, be finished parallel with the bottom of the jig feet. The operation illustrated is typical of a large number which are conveniently accomplished by the method indicated.

Internal Grinder for Cutters

A special bench machine for grinding out the holes in cutters and similar work is represented by Figs. 6 and 7. In this machine the wheel head remains stationary and the headstock carrying the work is reciprocated by means of the hand lever at the right-hand side of the machine. The lever is connected by a rod with the sliding head and the latter is easily slid to and fro by the operator. The head has a cross adjustment upon the slide by means of the knob shown at the front in Fig. 6, and the work is in this way adjusted laterally until it is ground out to the size required.

In locating the cutter on the face plate, plug *D*, Fig. 7, is slid forward and used to center the work while the straps are being applied. It is then drawn back out of the way by the knob at the rear and the grinding operation started. The wheel-spindle construction is shown in Fig. 7 and as there represented the spindle actually bears against the ends of a series of plugs formed of lignum vitæ. This has proved a very satisfactory form of bearing for this high-speed spindle which runs at about 25,000 revolutions per minute. A flexible coupling is used at the rear end of the spindle by which the latter is operated from the short spindle carrying the driving pulley; this connection effectually prevents any strain or vibration due to the belt pull from being transmitted to the spindle itself.

As the operator has complete control by the hand lever of the rate of feed of the wheel through the work, he can remove considerable stock at each passage of the wheel by traversing the head at a relatively slow rate of feed. In finishing, lighter cuts are, of course, taken with an increase in the rate at which the work is fed past the wheel.

Grinder for Cutters with Round Corners

Figs. 8 and 9 illustrate another special machine which is used for grinding the teeth of convex or concave cutters and straight-face cutters having round corners. The cutter is so mounted in this machine that it may be swung about a center in order that the teeth may be ground to any desired radius; or the cutter may be traversed directly past the wheel while straight faces are being ground on the teeth and then swung about the pivotal point so that round corners of the necessary radius may be ground at either or both ends of the teeth.

Handling the Cutters

As shown in Figs. 8 and 9, the cutter is placed on an arbor carried by a slide *E* which in turn is mounted crosswise on a slide *F* which has a radial movement on a pivoted arm *G;* this arm is adapted to be oscillated between adjustable stops secured in the upper face of plate *H*. The latter is mounted on a table which has longitudinal and cross movements by lever and hand wheel and vertical adjustment by means of hand wheel and elevating screw as represented in Fig. 8. At *I* is a hardened plug with two sides flatted to correspond to the center line of the post upon which the cutter head is swung and opposite this plug on the end of slide *F* is a hardened stop *J*. To set up for grinding a convex cutter, size blocks are placed between *J* and *I* to locate the cutter periphery at the required point relative to the center of the swiveling head in order that the desired radius may be ground when the head is swung to and fro past the grinding wheel; similarly size blocks are placed between central plug *I* and a stop under upper slide *E* to locate the cutter sidewise centrally with the swivel center. In this position the cutter is then ready to be oscillated past the wheel. For this purpose the handle *K* is employed, the stops *L L* limiting the arc of movement.

Grinding Straight-face Cutters

Where a cutter having straight teeth with rounded corners is to be ground, the cutter head is adjusted by the size blocks to give the necessary setting for the desired radius for the corners, and the work may then be traversed past the edge of the wheel for grinding the straight portions of the teeth.

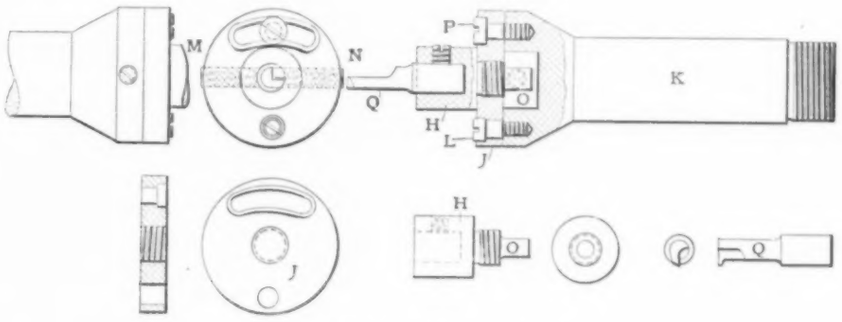


FIG. 4. ADJUSTABLE BORING TOOL

The round corners are ground by oscillating the cutter head about its center as in the previous case, the stops *L L* being set to prevent the cutter swinging so far as to be nicked at the side or on the face of the tooth by the corner of the wheel.

The large hand wheel at the front of the knee for moving the table in and out is provided with a stop screw which is located on the inner face of the rim of the wheel and which contacts with a swinging stop plate attached to the knee. The location of the stop screw on the rim of the wheel allows the table to be accurately brought up to a predetermined point no matter how often it is run back during the grinding operation, as it is impossible to deflect the stop, at least to anything like the extent it would be deflected if it were near the center of the handwheel shaft.

Use of Size Blocks

A box of size blocks is shown on the grinder table. These are used on the machine wherever it is being set up for cutter work. Two large blocks, one of which is shown at *M*, Fig. 8, give at once a setting to bring the center of the cutter arbor and the face of the collar against which the cutter rests, central with the swivel post of head *G*. It is then a simple matter to select additional size blocks which will give the correct setting of the cutter slides for any diameter, thickness, and radius of cutter.

This machine enables the teeth of a cutter to be accurately ground after hardening and also permits the grinding of a clearance angle on the teeth which is best suited to the material and work in hand. As illustrated in Fig. 8, the wheel used is of saucer form, and the wheel spindle is located at an angle of about 30 degrees with the center of knee and column, thus presenting the working edge of the wheel at a convenient angle to the face of the cutter to be ground.

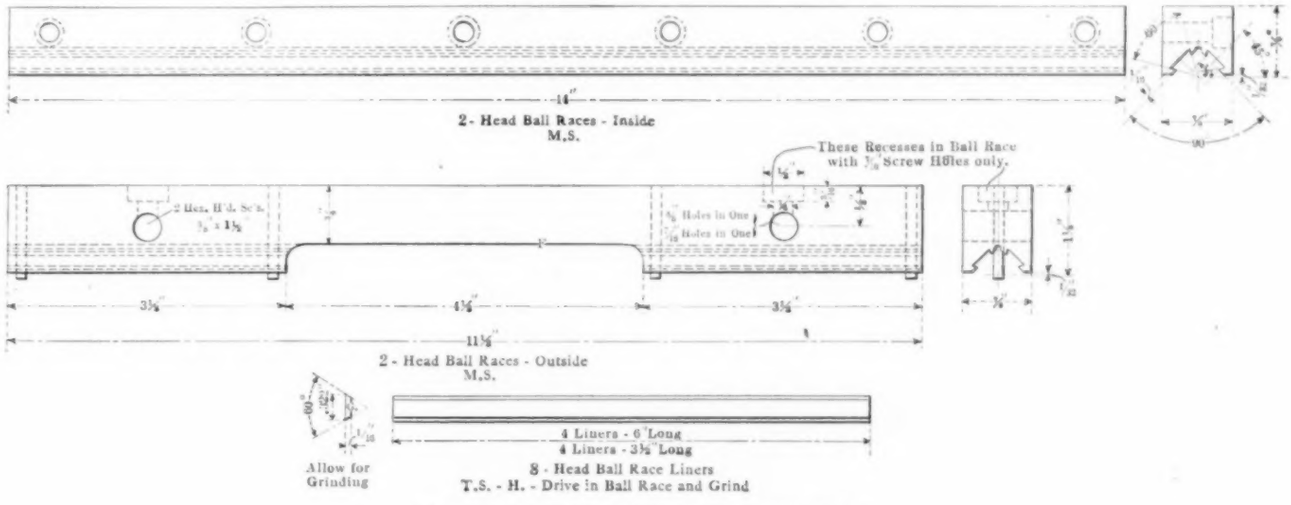


FIG. 3. BALL RACES FOR BORING-MACHINE HEAD

Machine for Relieving Counterbores

The bench machine in Fig. 10 is arranged for backing off the ends of counterbore lips, an operation it performs very rapidly and with uniform results. The

counterbore, after it is milled, is placed in the draw-in collet in the spindle with one land against the tooth rest *A* mounted on the face plate. After the collet is tightened on the work by turning the knob at the rear end of the spindle, the tooth rest is removed and the machine is ready for operation. The backing-off tool is carried in holder *B*, which is provided like a box tool with a guide bushing to receive the end of the work. The tool is fed forward by a cam to back off each lip as the counterbore rotates. The cam and other mechanism are clearly shown in Fig. 11. In this view a three-lip cutter is shown in place of the single cutter seen in Fig. 10, this cutter also acting as a supporting bushing for the end of the counterbore. In other respects the device is practically the same as illustrated in the half-tone.

Operation of the Relieving Device

The backing-off tool is carried by a sleeve *C* which is mounted loosely on shank *D*, the rear end of which fits the taper hole in the footstock spindle. The sleeve can slide to and fro with the cutter, but is prevented from rotating by a key. At *E* is a cam which is rotated by driver *F*, the latter being driven in the manner indicated by the face plate on the head spindle. The cam *E* has as many teeth or lobes as the counterbore has lips, and as the latter rotates, the cam and the spring *G* move the cutter to and fro to relieve each lip as it passes the cutter. The cams are readily changed to suit the work and the machine operates very rapidly. Ordinarily a single driving stud is used to connect the face plate and the cam driver, and this stud as illustrated at *H*, Fig. 10 is fitted with an adjustable stop so that the cutter may be fed to a certain point for each counterbore. The feeding is accomplished by turning the knob at the end of the footstock spindle. A ball-thrust bearing is provided as represented at *I*, Fig. 11; and a locking pin is fitted to the head as at *J*, Fig. 10, to hold the main spindle while work is being gripped or released in the collet. Two of the cams and a number of counterbores will be seen on the bed of the machine.

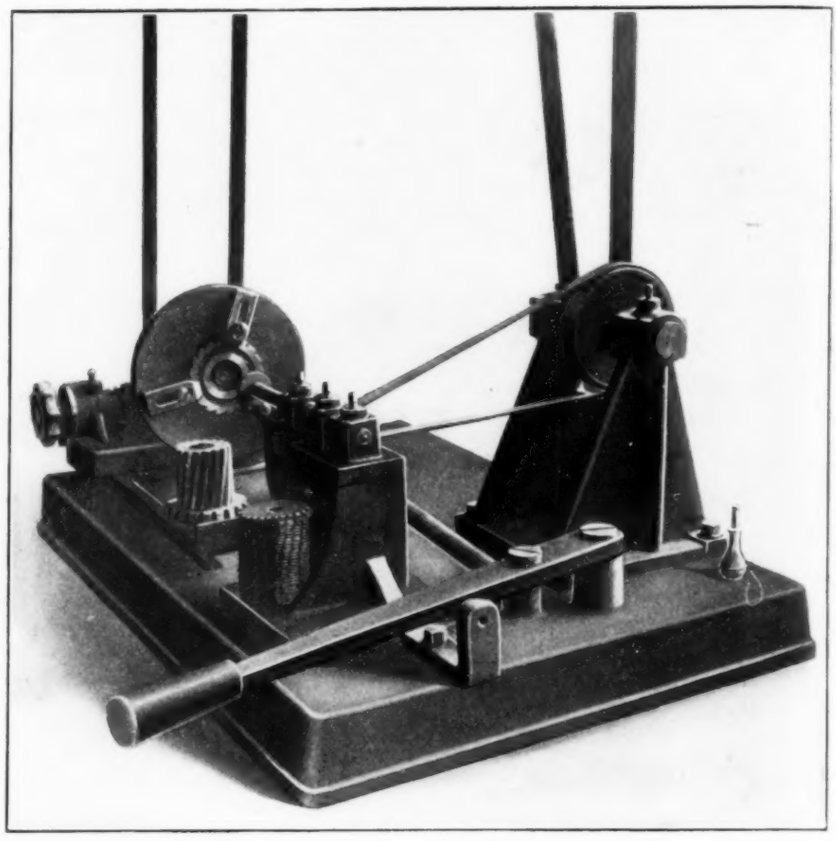


FIG. 6. INTERNAL GRINDER FOR CUTTERS WITH HAND OPERATED TRAVERSE FOR HEAD

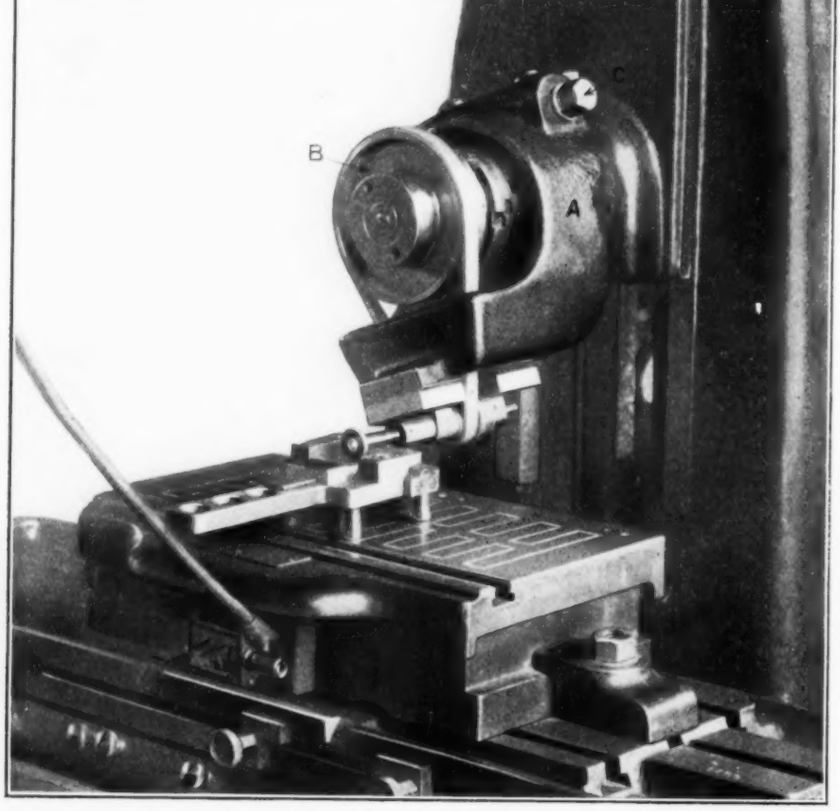


FIG. 5. SPECIAL ATTACHMENT FOR SURFACE GRINDER

Punch and Die Work

Naturally punch-press tools are used extensively in the manufacture of the Underwood typewriter, and a number of typical punches and dies are illustrated in Fig. 12. The punch and die blanks are made in quantities so that when a toolmaker starts a die job he has a blank already machined which he can start laying out immediately. The die blanks are planed up in long strips and cut off to length. Three sizes cover most of the requirements. A number of these blanks will be noticed at the rear of the group along with several standard punch holders and

punch blanks which are produced on the turret lathe ready for finishing by the toolmaker. The workmen use size blocks extensively when laying out punches and dies and three sets of these blocks which have already been referred to in this article, will be seen among the group of tools in this half-tone. The wood cases in which the size blocks are kept are provided with a retaining rod pivoted at each end, so that when swung forward it holds all the blocks securely in place. When tipped back it allows any block to be removed from its slot in the case.

Press-tool Construction

The construction of the press tools is shown sufficiently to make unnecessary any detailed explanation. It will be noticed that the punches are in most cases built up of several numbers, thus facilitating construction and cutting down cost of maintenance. The piercing punches inserted in the punch bodies proper are made with standard size shanks and are readily replaced when worn out or broken. Pieces to be blanked and pierced are handled in one set of tools of the tandem class, and piercing punches perforating the holes at the first stroke of the press and the stock then being fed along so that at the next stroke the piece is blanked out and the holes punched for the second piece. At *A* and *B* are shown two parts with the press tools for making them, the piercing and blanking punch for *B* being shown to the left of the piece and the die to the right. The other tools illustrated are of much the same construction.

The blank at *C* is bent to the form shown at *D* by the compound bending tools *E* and *F*. The blank is placed in die *E*, and as punch *F* descends and forces the blank down into the die the sloping surface at *G* strikes the end of slide *H* and forces it against the work, which is thus formed to the shape of punch *F*. The latter is thinner at the top than at the bottom to allow the ends of the fingers on the piece *C* to be folded closely to the body, as seen at *D*. On the up stroke the punch *F* lifts the work out of the die and the piece is then removed by sliding it endwise off the punch.

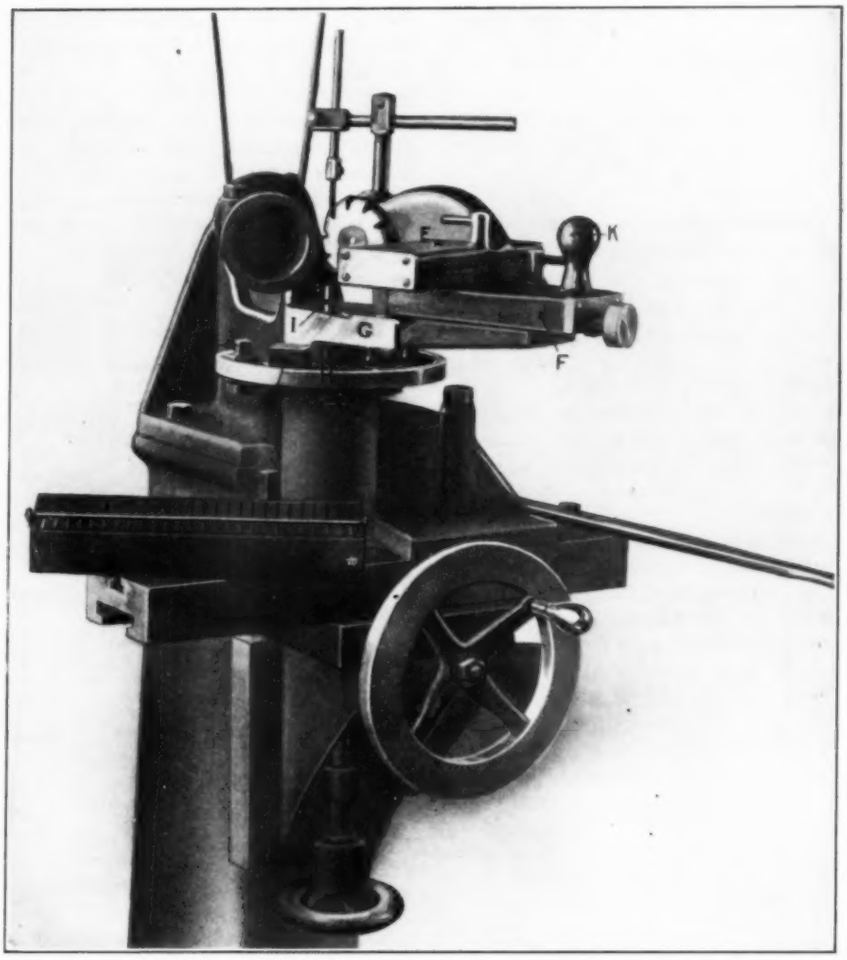


FIG. 8. CUTTER GRINDER

The social structure here in America does not rest on anything so slight as the hight of a man's collar or the pattern of his shirt; and the plain fact of the matter is that the skilled master of a trade, with his higher wages and the advantages of a better home and better furniture, and all the other things that money will buy; with his certainty that he can always secure work in one place if not in another, and with the independence of character which that knowledge breeds, is a bigger man and a better citizen than his softer-handed brother of the more "genteel" counting-room.—*The Youth's Companion.*

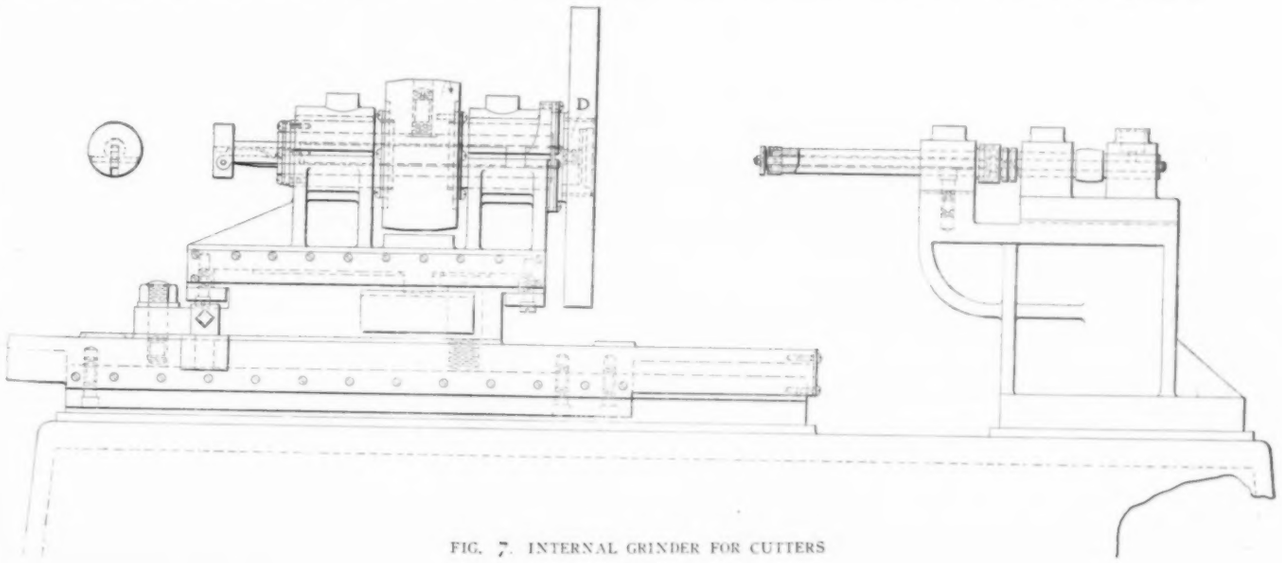


FIG. 7. INTERNAL GRINDER FOR CUTTERS

Worcester's Canvass in the Interest of a Trade School

By Entropy

There has recently been published a partial report of the results of a canvass of the City of Worcester, undertaken by the State Commission on Industrial Education to sound public opinion as to the advisability of establishing a trade school. The canvass was made among the parents of children who were last year in the four grades of school below the high school, thus covering the pupils who, four years hence may be in the high schools or their equivalent.

Some 5000 children's cards were turned over to the convassers, each giving the name, address, and occupation of their parents. These 5000 cards were found to represent roughly 4000 families, of which number 3708 were actually interviewed. These families had 4625 children, 2367 boys and 2258 girls. Of this total number the parents of 1374 boys and 1185 girls expressed a desire to send their children to a trade school, which should teach some trade which they might wish their children to learn; 3073 parents expressed themselves as favorably inclined to the establishment of a trade school along the lines proposed by the local commission, and which has been mentioned in your columns.

Out of the whole number only 304 parents showed entire indifference to the school, and only two were recorded as opposing it. Of these, both were reported as not wishing to go on record as favoring anything which would lead to increased taxation. No active opposition whatever was encountered. No very material variations were suggested from the plan as outlined by the local commission's report. A very few people inquired about the Fitchburg plan, but even these seemed to be convinced that it was not best for a city with the varied industries of Worcester. Some 480 children had reported that they did not expect to go farther than the graded schools, whose parents wished to send them to a trade school; about an equal number, or a few more, are expected to go through the regular high-school courses, and then to college or some technical school.

Making all possible allowance for the effect of enthusiasm, there appears to be a pretty definite public sentiment in favor of trade education. Since the proposed school, if carried out will be a strictly State and city school, without allegiance to any organization of either labor or capital, it would seem proper to discuss how the objections to State-supported trade schools, which were presented in your editorial on page 256, Volume 31, Part 1, can be met. I might say here that in discussing this matter with one of the canvassers I found that in his private opinion, as influenced by his discussion of this matter with parents he had met, was that a very much smaller number of parents would have favored the movement if it had been connected with either a labor organization or a manufacturer's association. That is, he believes that a purely neutral school is the only acceptable solution of the problem.

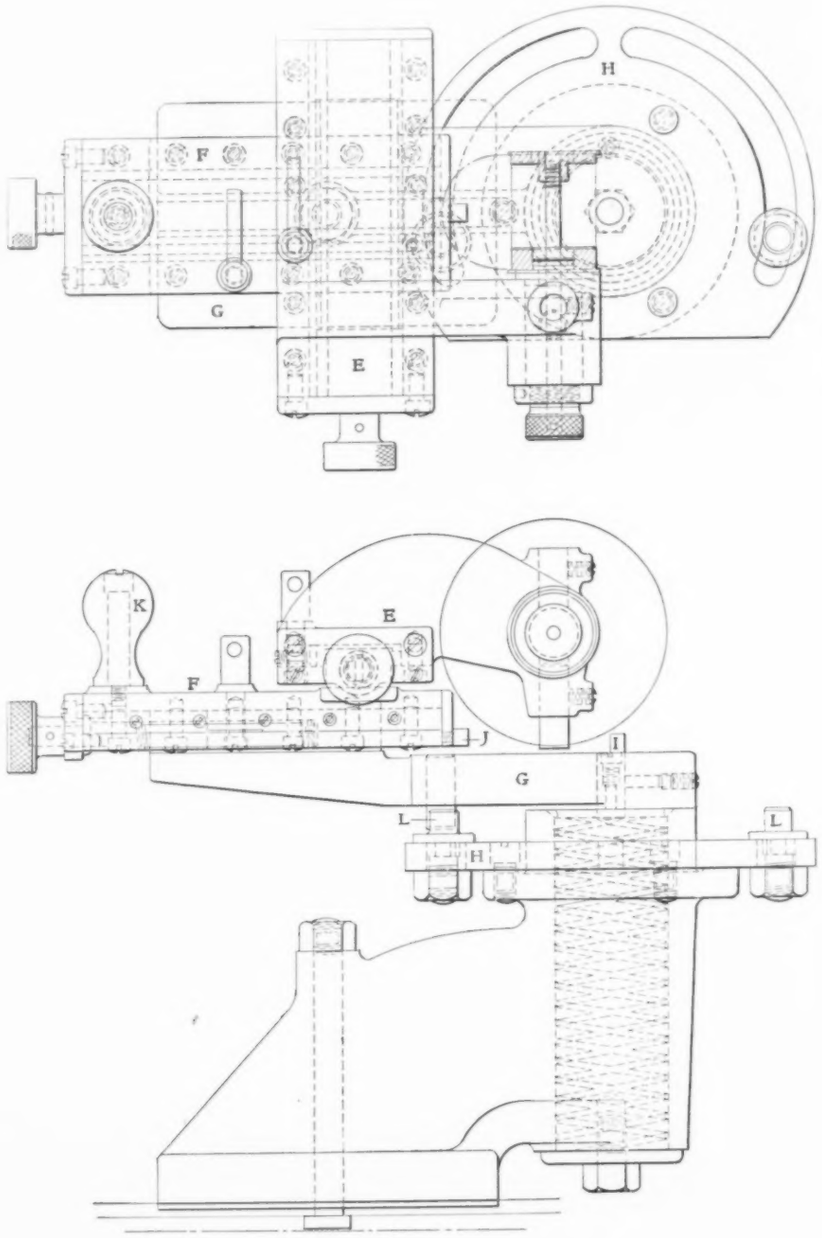


FIG. 9. SWIVELING HEAD FOR CUTTER GRINDER

What Can Be Made

First, let us ask "what can be made?" since the plan distinctly calls for commercial shop work. To this I will say, as I have said before, that the prime essential is that everything that is made shall be sold for the top market price, or else not sold at all. Suppose that A is already in Worcester and is building upright drills. If B comes to town and starts in to build drills of practically the same design, A may be sorry, but he cannot, and as a matter of fact he does not, care very deeply for anything except that B shall not cut prices. If he thinks that B is cutting prices then he looks at once to see if he is doing it by unfair means. If B is paying no taxes, A feels that is unfair. On the other hand if B is getting good prices, and is always willing to cooperate with A to boost prices, then A is really likely to be loyal enough to the city to be glad that B came to town.

No one has so far intimated that a State-supported trade school could become self-supporting. While I do not think such a condition altogether impossible, I do not think it likely to be the case in

Worcester if boys are allowed to enter at 14 years, as is proposed. In either case I would add to my first essential that the money derived from the sale of manufactured goods should be used to reduce the taxes necessary for the support of the school.

Designing Articles to be Made

I feel that a very different attitude toward design should be held by a trade school than rightly belongs to a technical school. A technical school teaches design, or should. A trade school has no legitimate excuse for teaching it. It should teach drawing, but that is another thing and can be taught and well taught without going beyond the making of working drawings of things which have been designed by others. Therefore, I feel that it is out of the province of a trade school to design new goods for the market. There is an ample amount of work, the design of which has become so nearly standard, on which any man who could possibly have ambitions to take charge of a trade school could readily do what little designing might be necessary. The training for a machinist, patternmaker, blacksmith or draftsman in working up and manufacturing such a machine would be none the less, because it had no weird devices upon it to cast a spell over the purchasing public. Therefore I would add to my specifications for work to be done in a trade school that it should be standard in its nature.

Selling the Product

While it is true that many shops do maintain elaborate sales departments, it is also true that many turn all of that work over to agents in the larger cities, and still do a comfortable business. While I think that such an arrangement is in many cases a poor one for a small, weak concern, short of working capital, I think that a school shop with the credit of a city back of it could do it to advantage. Then, too, there are various lines of goods which nearly sell themselves. Anything which is standard in its nature, whose quality is easily determined, will be sought out by purchasers no matter how carefully hidden, if the quality is exceptional.

Was it Emerson who said that if a man preached a better sermon or made a better mouse trap than his neighbors, that the world would beat a path to his door? It is true that a sales department, well managed, may turn the path into a side track and send people up to take away the mouse traps by the carload.

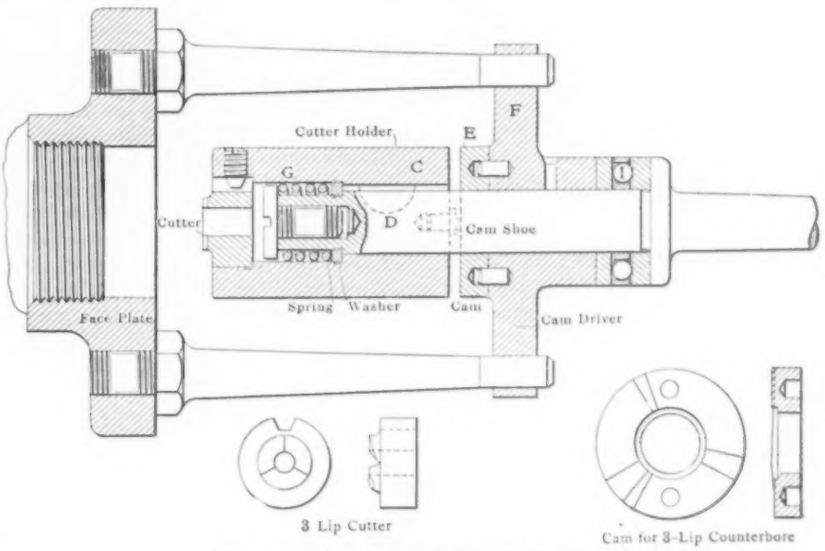


FIG. 11. TOOL FOR RELIEVING COUNTERBORE

In the case under consideration, however, quality costs less than nothing. That is, the school cannot afford to let work go out which is not at least up to market requirements, which in turn, means that to be sure that it is up to the market it must be better. Then too, the real product of the school being men, the rest by-product, it will be impossible to do the work too well so that both will work

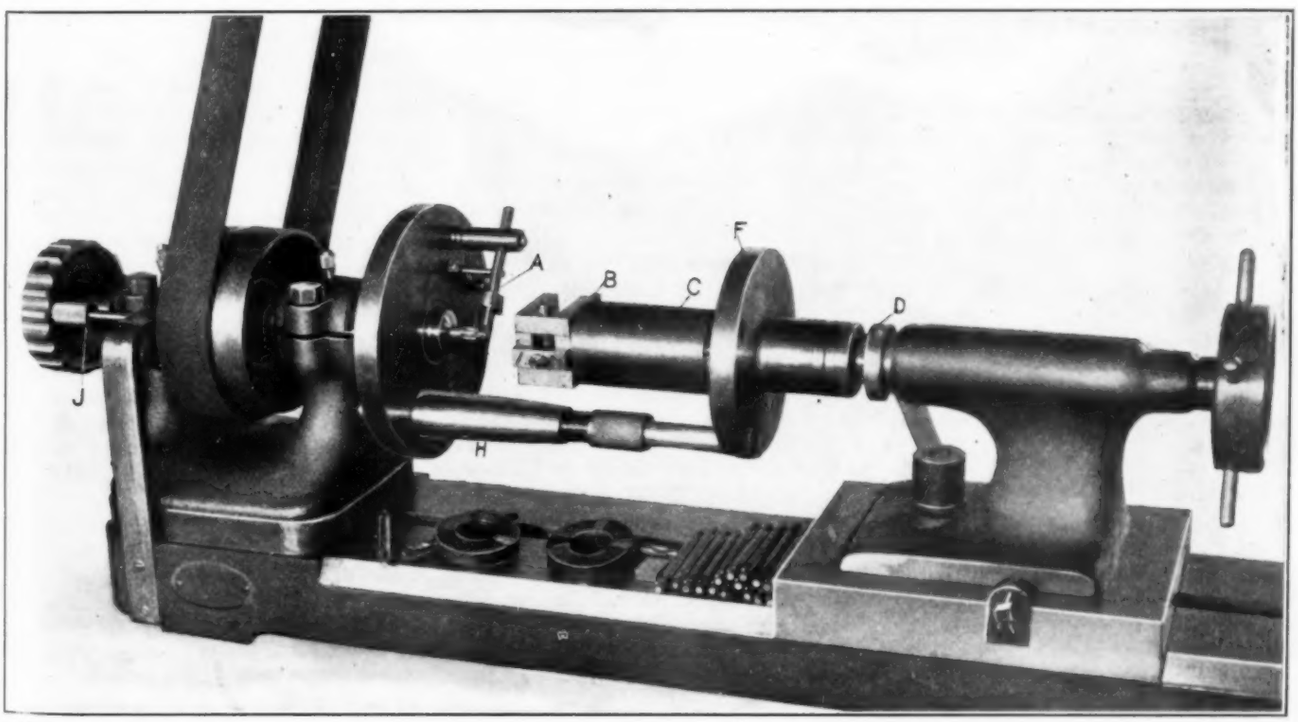


FIG. 10. MACHINE FOR RELIEVING COUNTERBORES

together, the necessity of doing the work well to make it sell itself, and the necessity of doing it well to train its students.

You say, that to you, this establishing of commercial shops by the State spells socialism. Every time the State builds a road which a hundred contractors are prepared to bid on, every time that the Government turns out a rifle, or a heavy motor, or a ship that manufacturers or builders would like to build, it must spell socialism.

Prison-made Goods

How about the comparison with prison-made goods? How about the attitude of manufacturers? No one can predict what that attitude will be, but we can surmise what it ought to be. The objections against prison-made goods can come from the poor quality and the low price; the two go together. The poor quality came from the unskilled labor, the absolute lack of ambition and care on the part of the workmen and the equal lack on the part of the foreman whose duty it is to direct the work. Anyone who has seen prisoners at work cannot wonder at the feeling that there is against their product. The low quality, of course, means low price to get the stuff on the market, and that, of course, means a general tendency to crowd down both quality and price of goods made in the open. The public is not discerning enough to discover the reason for the lowness of the price.

Some Dangers

I realize only too well that there is the most serious danger that some trade schools may not realize the dangers that are sure to befall if they allow this cheapening of product and skill. I realize too that the slogan of the Chicago meeting, "give every boy a chance," *must* be interpreted to mean only that the *chance* is to be *free*. If the boy does not take the chance and improve it, he must not be allowed to complete his course. No diploma should be given a boy who has not most assuredly earned it. The course must be long enough and severe enough to weed out the trifler; it must be very distinctly impressed on prospective students that the school's diploma is worth working for. Employees must know that the diploma stands for something, so that they will not give a boy a job on his mere say that he went to the ——— trade shcool a year or two.

There is only one possible successful path for a State-supported trade school, and that is the path of absolute fairness. But I firmly believe that there is such a path and I believe that if it is followed all the difficulties to which you refer will gradually fade away. I believe that the school should and would coöperate with manufacturers and with the laboring people, whether organized or not, and I believe, as this Worcester canvass seems to show, that people are now ready for the experiment.

Discussion as to what disposition was to be made of one hundred and fifty odd thousand patent models that had been accumulated by the United States Patent Office up to the year 1880 is reported to have been finally settled by an act that has been passed directing that the entire collection be placed in the new National Museum building, in Washington, and be under the supervision of the Commissioner of Patents. Among the collection are a great many mechanical devices showing in the most interesting manner possible the development in mechanical lines up to year mentioned, at which time the requirement of submitting a model with each application for patent was discontinued and mechanical drawings only were required. This disposition of these models will be looked upon with favor, because of their historical value, which will increase as time goes on.

Patent Experiences—One That Wasn't Applied For

By Wit Bec

The readers should note that I am speaking of two great classes of inventors—one skilled in mechanical work, capable of making the finest models (my friend Joe is an expert mechanic), and the other (of which I am one), who are not earning a livelihood as mechanics. Success is far more generally conceded to the first, while the second class less often achieves it. Success is one on the side of the skilful mechanics in the majority of my acquaintances.

The matter of cost to be an inventor was very often a topic of conversation between Joe and me. Note that it is said "the cost to be an inventor" and not the cost of a patent; because the cost of the patent is merely a small item as compared with the whole expense. Many inventors think that the necessary models and the fees for patent rights limit the expense; not so, there the expense only starts, because to personally get this patent marketed usually costs quite a sum of money. There is the trip to see the manufacturer with all its many expenses; the expense incurred to get someone to adopt the device for thorough trial, possibly before a manufacturer is sought; and usually and lastly, the perfecting of details requiring several models, and many additional patent rights.

This is illustrated by glancing at any important invention and noting the list of additional patents; my Remington typewriter, of an old model bears the stenciled information, "This machine is protected by 67 American and Foreign Patents." An Edison phonograph before me bears a list of 16 patents on the name-plate; a shredded-wheat package gives a list of 41 patents.

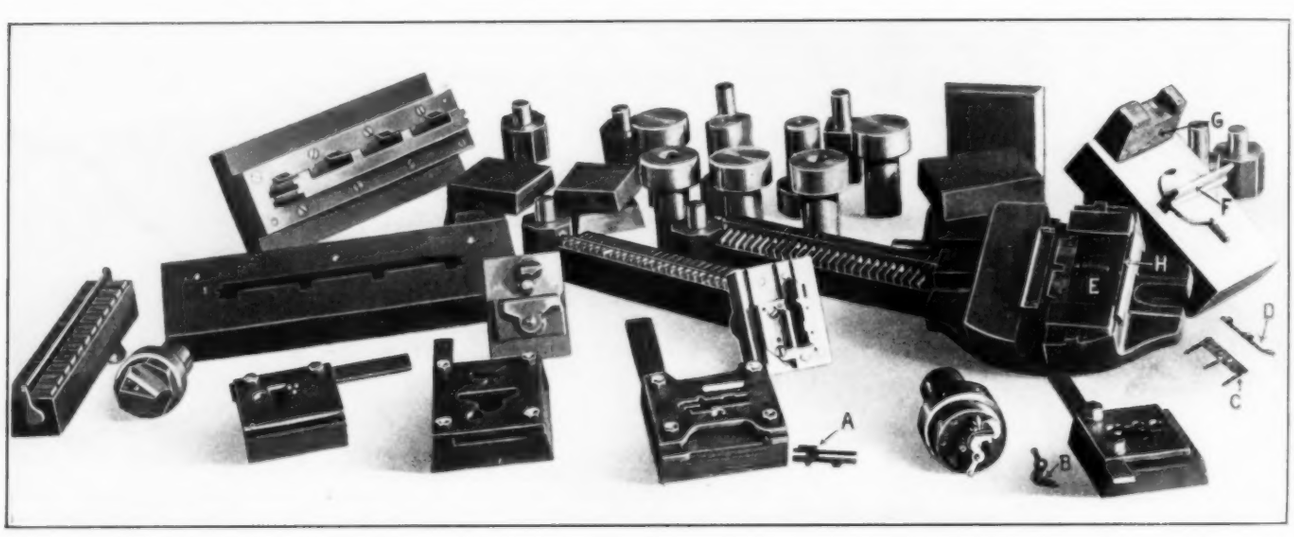


FIG. 12. PUNCHES AND DIES FOR TYPEWRITER PARTS

Actual Costs of Patents

I asked of Joe one day, "Do you feel that you are ahead on your patents?" "No," he answered, "for although I sold one for $2000, netting me at least $1800, yet one single patent before that cost me nearly twice as much. Had that invention been of a simple nature and as inexpensive as the one I sold, I would be to the good. How have your experiences been?"

"Well Joe, the cost of patents alone is not all with me," I was forced to reply. "You make a living from your workshop and do not consider its equipment as a necessary part of your patenting expense. In my case I must so include it, as my living is made in other ways, and mechanics a hobby pursued with hopes of success. My first patent cost only about $107; the second cost about $265, and the third about $105, for fees and models only in each case. But Joe, I have paid invoices at home that I carefully listed and footed which brings the total up to $1370. This sum contains only those items for which I got and filed away a paid invoice; certainly there are other items during the six years covered by these three patents for which invoices were not received, that will easily bring the amount to about $1500."

The above figures are my actual experiences on three simple patents. I must add too, that not one of them could be sold; my opinion is that had two of them (or all three) been sold, the same amount of expense would be charged to the whole, because the necessary expenses of placing and selling would have brought the figures up to this sum.

"Wit, should we patent our ideas?" Joe inquired.

"We certainly shouldn't until we have used every possible means to determine what others have done along the same lines, and try to ascertain what demand there will be for our ideas," I replied.

"Doesn't a person run the risk of having an idea stolen if the attempt is made to learn its demand?"

"From my experience, Joe, I would feel flattered to originate an idea that others would care to steal. After a few failures, many of us would be quite willing to refer to another's patent saying, 'I got that up, but this fellow stole it from me.' I know of a case where an idea was so stolen and the firm is making money out of the manufacture of the article, though the originator was never recognized."

A Device That Looked Good

As to whether we should patent our ideas, an experience of mine will answer that. I had worked for about two years on a loose-leaf binder, having proceeded far enough to have had a working model in use for about five months, tried out by three of us who were working on that set of books. We all liked the idea and thought it would prove successful. Should I patent it? I asked myself. With due caution I wished to know what others were doing in the same line, and what place my book would fill with the buying public. So I sent to the Patent Office and got several hundred copies of patents covering the various classes to which mine belonged. If I remember rightly these cost 3c. apiece and my bill was about $17, so I must have got about 500 of them. I diligently studied every one, and knowing the successful binders then on the market, I very closely applied my attention to them. For all of one winter I studied these specifications. I searched for conflicts to my own idea, but found none; the way seemed clear. Next I laid my working model before a drummer for a blank-book house and he thought the idea good and went so far as to ask for an interest in it with me, and would use his efforts to place it.

Surely, from these two circumstances I thought I ought to proceed and get a patent right. I felt that I was justified in doing so. The judgment of the inventor is of absolutely no value in determining the worth of his ideas. He must appeal to the buying public, or to the representative of the buying public, the manufacturer. This patent, I judged, would cost me $300 to $400, as I had to obtain two patent rights, one for the mechanical binder, and the other for rights on the punching of the leaves and certain features designed to be carried on the leaves to make the book "perpetual" in the sense of carrying the names on sub-leaves. Nothing but the lack of the money kept me back. I was fully determined to patent it.

Result of Further Investigations

Then came an awful blow. In the late summer of 1908 I went into a certain large bank to get a digest of their methods of bookkeeping from one of my friends working there, and as soon as I told him what I wanted and how I expected it to apply to my own invention, he bluntly told me, "Why, we have been using that kind of a system heretofore, but have lately adopted the ——— system, and discarded everything for it. His system completely revolutionizes what you are working on and puts it out of date." I took it as hot air and wouldn't believe any of it. I felt slighted that he should so summarily set aside two years of work on my part, in effect telling me that I didn't know what I was talking about. So I asked to see the system, incredulous at first, and begrudgingly admitting anything for it, heaping up all kinds of criticisms against it, until he showed me four sets of books run on that system by as many bookkeepers, and I carefully followed each step right through from beginning to end.

Well, he had it. My work wasn't worth a tinker's dam with this new departure in the field. I greedily drank in every feature of it. My experience of fourteen years in that line showed me at once that he had it. My fond hopes of my own incipient invention died. There were four beautiful brand new books lettered "——— System, Pat. App. For." How I envied him! In answer to my inquiry of who made them, the name of a well known blank-book maker with whom I was well acquainted was told me. After that interview was over I called time and again on the book maker to examine this patent. It grew on me. As I said, at first I denied it anything. But I had to admit its merit at the cost of acknowledging my own defeat.

"Now, Joe, I just missed putting $400 more to my chunk of experience. My position was that of the man who has a very good invention on the old-style horse street car—it's an improvement on the horse car all right, but he sees the model of the trolley car before him. He's lost out, and the other man's new departure is the thing."

Summary

In conclusion let me summarize with the reader: A simple invention of small cost may be easily sold at a neat profit; other simple inventions may be utterly unsuccessful, though we, and others have faith in them; if a costly invention is unsuccessful, the inventor is badly crippled financially; a skilful mechanic more often attains success than an unskilful one; yet a person of no mechanical ability may get large rewards from an idea evolved, which he gets a good mechanic to perfect (the traveling salesman's ledger); there are many failures (in my own limited observation, about seventeen out of twenty); finally, there is the great reward of the very successful inventor for which we are all striving.

The results of experiments to determine the expansion of valves and fittings in service involving high temperature are given by the *Valve World*. Three flanges were taken, one of cast iron, one of ferro steel, and one of steel. They were exposed to varying degrees of heat for a period of 130 hours, the temperature being less than 500 deg. for 18 hours, 500 to 700 deg. for 97 hours, 710 to 800 deg. for 12 hours, and over 800 deg. for 3 hours. The average for 130 hours was 583 deg. The view previously put forth by the *Valve World* was that cast iron subjected to continued temperatures of approximately 500 to 600 deg. takes a permanent expansion and does not return to its original volume when cooled. The results of the above mentioned experiments are stated as follows: Cast steel flange—no change. Cast-iron flange—outside diameter increased 19-1000 inch, inside diameter increased 7-1000 inch. Ferro-steel flange—outside diameter increased 33-1000 inch, inside diameter increased 17-1000 inch.

Variable Speed Clutch for Machine Tools

Its Construction for Motor or Belt Drive, also Constant Return Speed. Application to All Machines that Require Different Speeds

EDITORIAL CORRESPONDENCE

The accompanying illustrations show a variable-speed clutch intended for use as a substitute for cone pulleys and other speed-varying devices. It is now being placed on the market by the Variable Speed Clutch Company, of Milwaukee, Wis., after considerable use in leading machine shops of that city.

Motor-driven Clutch

One of the clutches that are to be made for general use is shown in Fig. 1, connected to a motor with a flexible coupling, so it can be motor-driven. Both the clutch and motor are mounted on one solid base with sliding rails for adjustment. It is designed to set on the floor, and the half-tone shows it as it was being tested. This is the 24-inch size, that is, the clutch drum is 24 inches in diameter. This type may also be suspended from the ceiling or sidewall where floor space is limited.

When this particular clutch is put into operation, the air controls, which are shown on the floor, to the left of the clutch, will then be located on the machine, within easy reach of the operator. The air may be obtained from an existing air supply, or a small air pump that can be attached to the main shaft and be operated by it.

In operation the clutch is instantaneous in its action. It is controlled by compressed air, which operates on a piston that moves in a cylinder, through two valves. One valve is for the purpose of turning on and off the air to start and stop the machine, while the other is a pressure reducing valve to raise and lower the air pressure. This increases or decreases the speed of the machine and hence the speed at which the tool cuts.

While compressed air is used to operate the clutches illustrated in this article, other fluids can be substituted with good results.

The speed-control valve can be operated while the tool is taking its cut, and any speed between the maximum and minimum can be instantly obtained by turning the nurled disk at the top of the valve, the speed responding instantly to the change of pressure obtained by operating the nurled disk with which the valve is fitted.

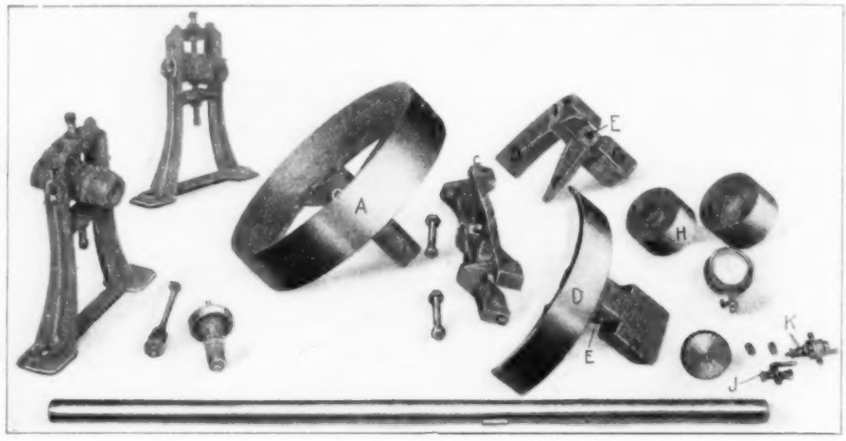


FIG. 2. ALL THE PARTS OF THE CLUTCH READY TO ASSEMBLE

Construction of Clutch

The construction of the clutch can be seen by looking at Fig. 2, which is a view of all of the different parts

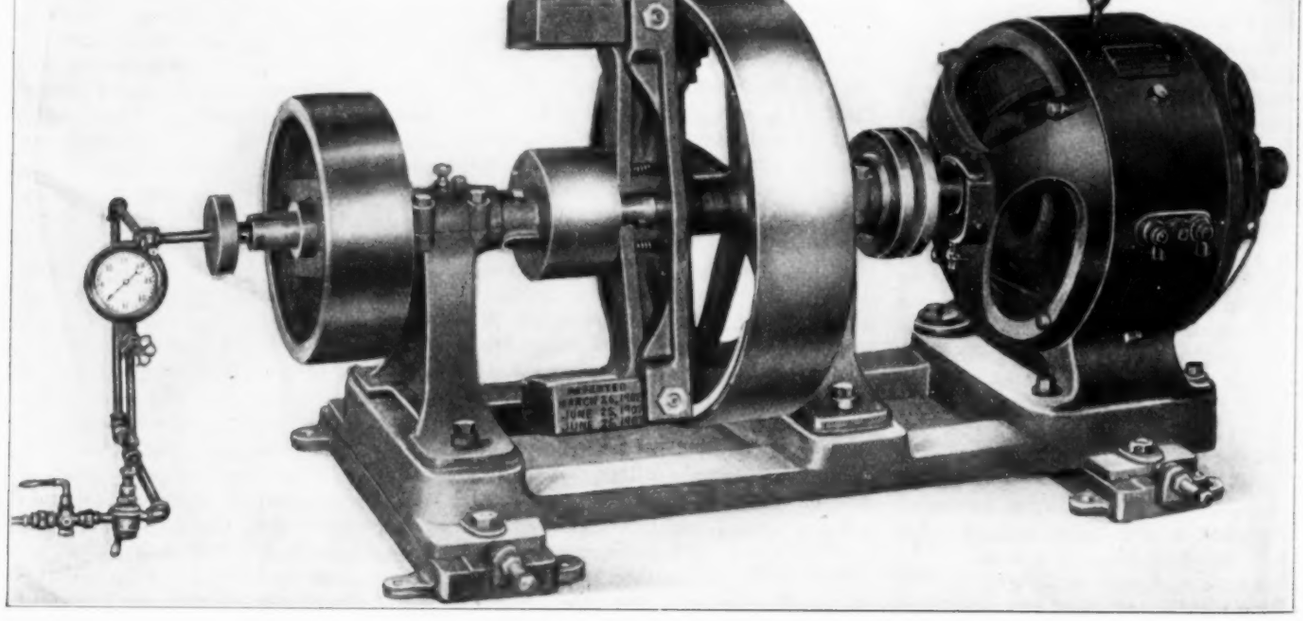


FIG. 1. VARIABLE SPEED CLUTCH FOR GENERAL USE—MOTOR-DRIVEN

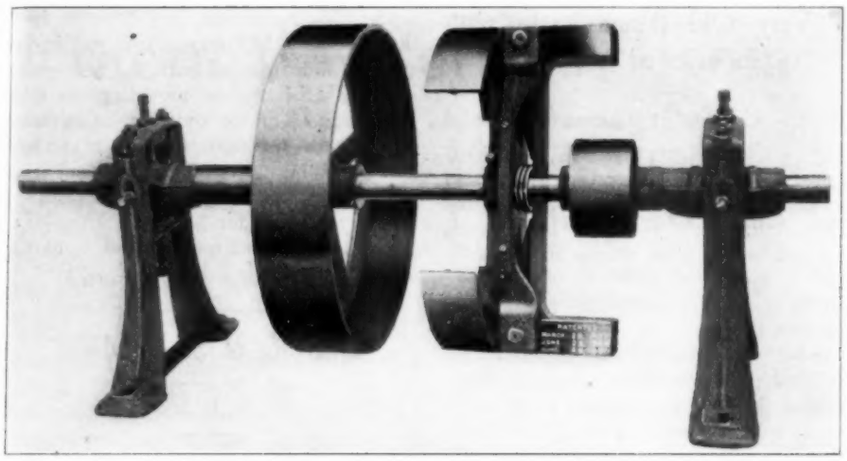


FIG. 3. ALL PARTS OF CLUTCH ON SHAFT READY TO SLIDE IN POSITION

as they are ready to assemble, even to the bolts, valves and pressure gage. In Fig. 3 will be seen a view of these parts as they are assembled on the shaft, ready to move into their respective positions, and Fig. 5 shows the same placed into position and completely assembled, ready to hang to the ceiling. These three halftones show the clutch that is belt-driven and designed for ordinary use.

In Fig. 2, *A* is the brake drum. On the inside of the rim it is finished so the clutch shoes can have a good bearing. On the opposite side of the spokes an extra long hub is provided, on which to fasten the pulley that carries the belt from the main line shaft. *B* is the casting that carries the clutch shoes, which are hinged at *C*. This casting is keyed and fastened to the shaft directly in front of the drum *A*, by the set screw shown. *D D* are the clutch shoes, which are hinged at *E*. *F* is a lever that is cast to the clutch shoe. This lever extends to the shaft, and the piston presses against it when the air is turned on, to make the clutch shoe *D* grip the drum *A*. *G* is a weight that is cast on the clutch shoe, on the opposite side of the hinge pin. This weight revolves outside of the drum *A* and exerts a centrifugal force, against the air pressure. *H* is the piston, on the end of which is cast a boss to press against the lever *F*. *I* is the cylinder, *J* the stopping and starting valve, and *K* the speed-control valve that operates by means of raising or lowering the air pressure.

The drum always travels at the highest speed that it is desirable to have the machine work, the slow speeds being obtained by reducing the air pressure on the piston. This change in pressure momentarily changes the balance between the two forces, lessens the contact pressure of the shoes, and causes the driven member to slow down in speed, which it does almost instantly, to the point where the balance is again established.

The control of the speed is obviously due to the centrifugal action of the counterweights. As centrifugal force varies as the square of the speed a slight increase of speed results in a much larger increase in the centrifugal force and thus rapidly reduces the pressure on the brake shoes and as rapidly increases the slip. This action is seen in the case of a cut on a planer which is heavy and light in different parts of the stroke. Under these circumstances the action of the counterweight is so prompt and decisive that the speed of the platen is substantially uniform.

Special Planer Type

A special clutch for planers, as shown in Fig. 4 is made with a constant high-speed return for the platen. This return speed is made as high as the planer will stand, and this speed is main-

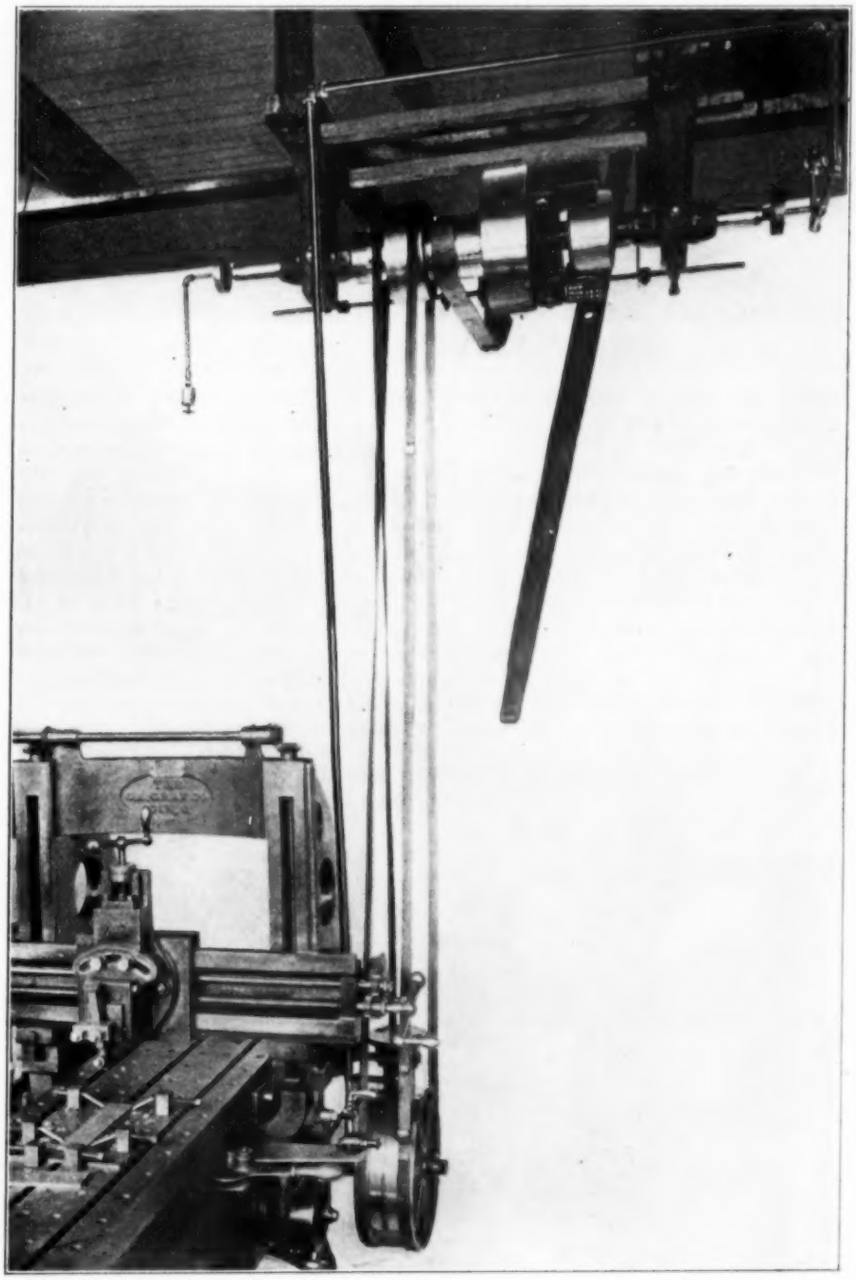


FIG. 4. CLUTCH IN USE ON PLANER IN SHOP OF A. O. SMITH & COMPANY

tained steadily, irrespective of the cutting speed, which is varied at the will of the operator from a mere crawl when cutting hard metals to the maximum speed when cutting the softest metals.

The return speed is made constant by fastening the return-speed pulley to an extra long hub that is cast on the drum, thereby making the two run at a constant speed by means of a belt from the line shaft. The loose pulley is located between the return-speed pulley and the drum, and runs on the hub of the latter.

For ordinary use the only moving part, when the machine is stopped, is the drum and its accompanying belt pulley.

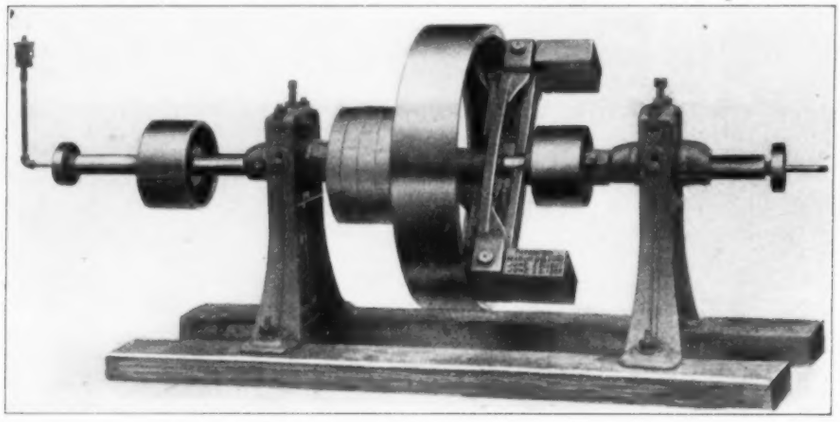


FIG. 5. 14 AND 18-INCH CLUTCH COMPLETELY ASSEMBLED READY TO HANG

This does away with the necessity of tight and loose pulleys as well as the multiple-step cone pulley.

The controlling valves, in this case, are located just in front of the driving pulleys of the planer, but, as it is only a question of piping, they can be located anywhere that is the most convenient to the operator.

Experience shows that the best proportioned springs are those in which the outside diameter of the coil is from six to eight times the diameter of the steel used.

A Very Old Bench Lathe with an Inverted V-bed

By W. J. Carrel

One of the most interesting exhibits in the show room of Sir W. G. Armstrong, Whitworth & Co's. Works at Manchester, England, is the lathe shown in the half-tone.

It is of the so-called "bar" pattern and was built by Henry Maudslay either at the close of the 17th or the beginning of the 18th century and is supposed to be the first lathe to have a slide rest.

As will be noted the bed is a triangular bar and is supported on three points, a feature used on machines of more modern construction. It is probable that the "American" inverted V originated in this or a similar lathe. The front bearing of the spindle is conical, the same as used in bench and watch lathes today. The rear bearing is a conical center which is adjustable for wear. The cone pulley has V-grooves in it for round belt. The front face is divided and a spring indexing pin is provided which can be swung out of the way when not in use.

The slide rest is not very different from the slide rests in common use, and shows the top slide parallel with the bed which is the English way of mounting the slide rest today. The top slide can be swiveled to an angle for taper turning or boring. The half-tone shows a hand rest and what is called a "collar plate," a species of steady rest used for boring.

The parts shown are believed to be the parts of the original lathe.

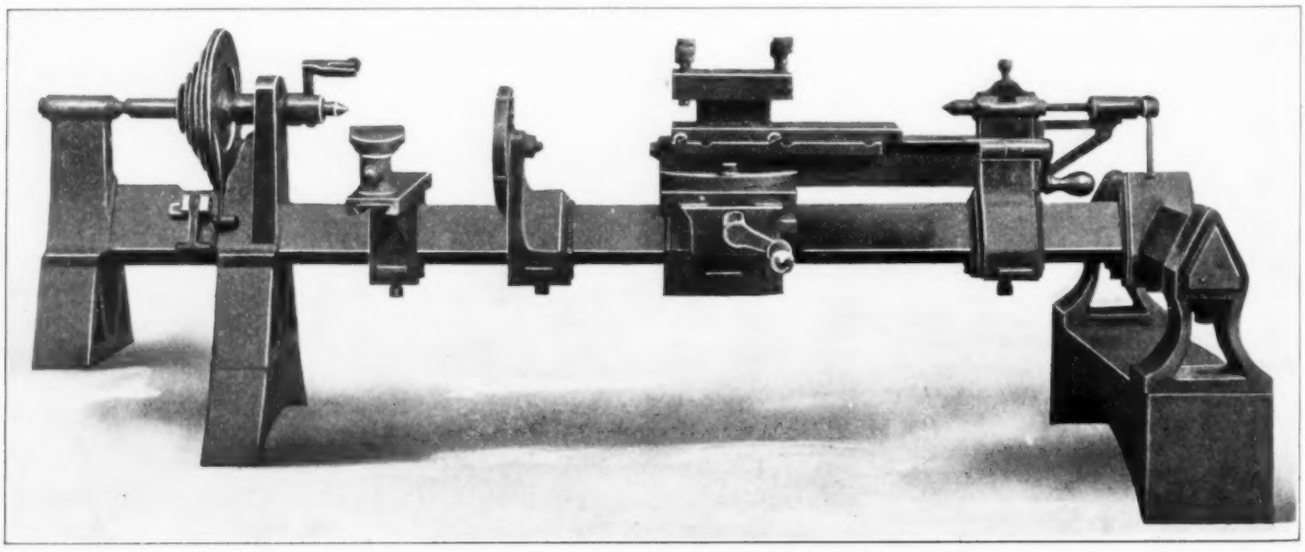
Drawing of Sheet Metal

By R. R. Pratt

In the drawing of sheet metal a cup is many times required of such proportions, as to diameter and hight, that more than one operation of reduction is necessary. It then becomes important to know the maximum amount of reduction that may be made in a single operation without punching through the bottom of the cup. Having the hight, thickness, and diameter of the required cup, the diameter of the blank may be calculated by geometrical formulas, or determined graphically by laying out on the drawing board to large scale.

To know how small a cup may be made from this blank is a matter of practical experiment, and it has been found that the diameter of the blank divided by 1.9 gives the diameter of the smallest cup that can be formed. This is about the limit at which breaking will occur with mild sheet steel, therefore the diameter of the punch may be made 5 or 6 hundredths of an inch larger for safety.

For successive reductions after the first one, divide the diameter of the cup by 1.28 to get the diameter of the next smaller cup. In the application of the above rules no reduction in the thickness of metal is considered; the thickness of metal in the finished cup being the same as that of the blank.



OLD BENCH LATHE BUILT BY HENRY MAUDSLAY

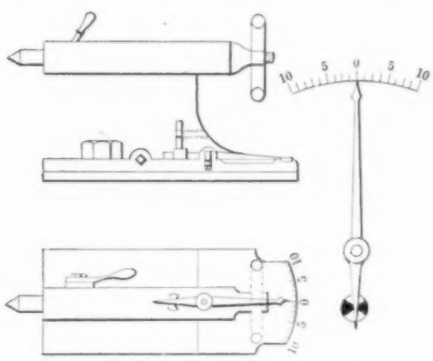
Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Graduations for Tailstock

Nearly all uptodate lathes have the cross-feed handles graduated in thousands. Why not apply this to the tailstock of the lathe and put it where it is always on top so that an operator can see it without twisting himself half under



PROPOSED GRADUATIONS FOR TAILSTOCK

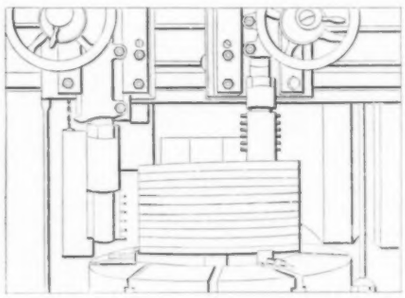
the handwheel? I submit a rough sketch which will explain itself.

I do not see why the lathe designers do not use rollers on the steady rest the same as the Jones & Lamson lathe builders do on their roller-box tool.

Davisville, Canada. W. LOACH.

Piston Rings

I am sending you herewith a newspaper cut of a rapid way of producing locomotive-cylinder packing rings, on a contract



MAKING PISTON RINGS

or piecework basis. The arrangement consists of two tool holders for a two-head boring mill; each holder is supplied with a number of parting tools which are set the right distance from each other by filling blocks. As shown in the cut, the tool holder is long enough to reach to the bottom of the cast-iron cylinder, which is to be made into rings, while the other is shorter.

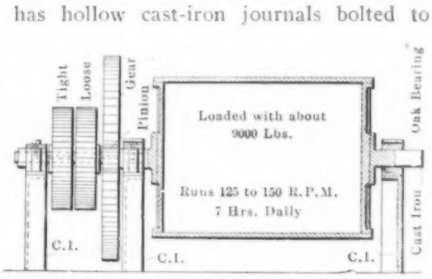
The outside diameter of the cast-iron cylinder is first turned to the right size, then the parting tools are fed in simultaneously from each side until they have reached a sufficient depth.

Then the inside of the cylinder is bored out by the boring tool on the reverse side of the short tool holder. Thus a ring is cut off as fast as the tool reaches a parting tool cut. This arrangement is in use, and said to be very satisfactory.

Port Jervis, N. Y. W. S. DRUMMOND.

Wooden Bearings for Tumbling Mills

Here are a few facts in regard to wooden bearings for tumbling mills. A certain mill, when loaded, weighs about 9000 pounds. It is square in section and has hollow cast-iron journals bolted to



TUMBLING MILL WITH WOODEN BOXES

the ends. See the accompanying drawing. The journals are 4 inches in diameter and 14 inches long. The mill runs 7 hours per day at a speed of from 125 to 150 revolutions per minute.

The boxes are of oak, 5 inches long, 8 inches wide, split and held in place by angle irons. They are oiled every morning.

The mill has been in use some 16 years, in which time the boxes have been replaced twice; the last time a few weeks ago. The boxes were worn about ½ inch large and the journals about ⅛ inch small. I doubt if any iron box would have run as long, about 8 years.

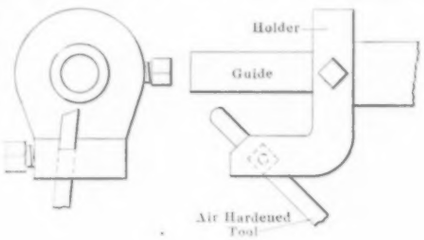
I am not defending the use of worn boxes, or of wooden boxes for that matter, but these facts may be of interest and value to some one, at a time of breakdown when an iron box cannot be obtained.

CLEMENT BENNETT.

Philadelphia, Penn.

A Cheap Hollow Mill

Among other things made in our shop is a brass stuffing-box nut 1½ inches long, 45/64 inch bore, 1 1/16 inches outside diameter, with a 10-pitch thread. As we make our brass castings from old metal it is sometimes very hard. I found it



A CHEAP HOLLOW MILL

difficult to keep an outside mill in working condition, especially with unskilled labor on the work. So I made a tool as shown in the sketch.

It uses an air-hardened tool fastened by a set screw. This can be taken out, ground and replaced very easily, by using a gage which is simply a small block of iron to slip against the machine-steel guide and locate the tool. Thus the grinding can be done by cheap help. This tool cost only about $1.25, which is less than an outside mill. It takes 5/16-inch square steel, such as used in lathe tools.

Fairbury, Neb. N. C. MICKELSON.

A Simple Water Turbine

Figs. 1 and 2 show the construction of a light turbine wheel for buffing, grind-

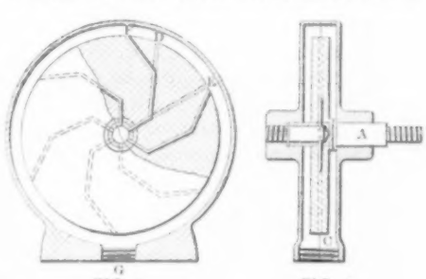


FIG. 1 FIG. 2

A SIMPLE WATER TURBINE

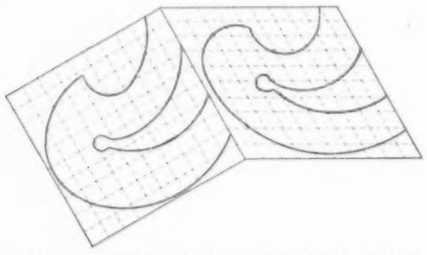
ing, etc., which I designed for use on domestic water mains. The frame is made of two similar castings. The draft side is not bored clear through for the shaft, but is tapped, as shown, to receive the supply pipe. At *C* is indicated a bronze disk pressed on the shaft *A*. Holes

are drilled as shown at *F D E*, Fig. 1. The parts of holes *D* and *E*, outside of the intersection of the holes drilled to meet, them are plugged, leaving the hole clear in the shape shown, thus forming a centrifugal turbine wheel of any desirable pitch. The hole *G* must be made large enough to allow the water to escape rapidly. There is nothing complicated about it, and it may be constructed by any mechanic. The speed may be easily adjusted by plugging or unplugging one of two holes, dependent on the speed desired.

Hamilton, Ont. W. H.

Isometric Projection of Compound Curves

I have been asked many times how complicated curves are to be put in on an isometric drawing. There are two methods: One by means of tangents, which I do not recommend for the unskilled, but which for all that everyone who makes use of the isometric system should at least understand, if he does not practice; the other by the very simple method known to



ISOMETRIC PROJECTION OF COMPOUND CURVES

map-makers (and I am sorry to say also by some so-called artists) by subdivision of the field into small squares.

An example of the latter procedure is given herewith. The subject is the handiest thing that occurs to me at this minute, the end of a so-called "French curve," which incidentally can be replaced to advantage on any draftsman's table by a "logarithmic" curve.

As seen in the accompanying figure the problem is to translate the outlines in the square into isometric projection. The isometric trapezoid or "lozenge" is drawn, with its angles of 60 degrees and 120 degrees, each field is then divided into an equal number of squares, and the rest of the work is done by the aid of the eye in fixing the joining points of the necessary short curves.

In this, as in all cases where curves are to be pieced together to make a composite one, care must be taken to join them only at points where the separate curves are tangent to a common radius; else there will be a visible break at the joint. This neat joining is facilitated by laying off at every half-inch, or so, on the wooden or other curve, a radius which is perpendicular to the curve's tangent at that point. ROBERT GRIMSHAW.

Dresden, Germany.

Repairing a Broken Air-chamber with Portland Cement

This has been called the "Cement Age." Of late years concrete has been put to many uses heretofore unheard of.

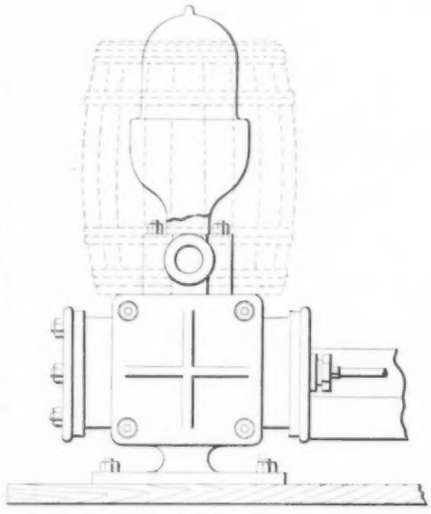
While it has acquired new uses—some of them novel—seldom, if ever before, has concrete had a place in machinery repairs. An account of a quick repair job, where concrete was a prime factor, may be of interest to the readers of the AMERICAN MACHINIST.

It happened away back in the country where a water-power plant was being built to furnish electricity to a town farther down the valley.

A Cameron steam pump was on duty keeping the water out of the excavation. By an unlucky swing of the derrick boom, a loaded dirt bucket struck the cast-iron air-chamber of the pump, snapping it off just above the discharge connection, putting the pump out of commission.

It was miles to a repair shop, and the prospects of delays attending repairs were exasperating. Things looked rather dark until the civil engineer in charge of the job offered his assistance.

At his suggestion the broken air-chamber was put back in position and an empty barrel, minus head and bottom, was placed



THE BREAK AND THE REPAIR

over it, as shown in the accompanying illustration, the staves having been cut away to let it go over the discharge connection. All holes and openings between the barrel and the valve chest were then plugged up with cement sacks and the barrel filled with concrete.

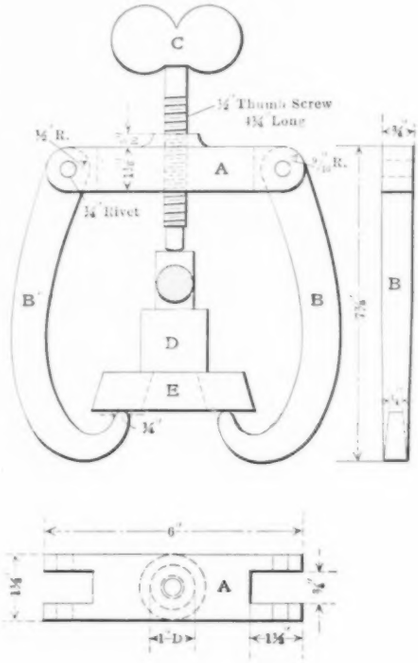
The pump was shut down for a day to let the concrete harden. When it was started again it worked along as if nothing had happened to it and continued on duty until the job was finished.

New York. C.

A Clamp

The clamp shown in the line cut makes a very convenient tool for holding together two pieces of work while transcribing the outlines of one on the other or anything of a similar nature. It is of very simple construction, consisting of the head or bar *A*, the legs *B* and *B'*, and the thumbscrew *C*.

By omitting the boss on *A* it may be made from a bar of tool steel 1⅛x1½x6 inches; the slots being milled in each end to receive the legs, and a ½-inch tapped hole drilled in the center, as shown. *B* and *B'* may be made from a straight bar machined to the dimensions shown, then



A HANDY CLAMP

heated and bent to the required curve. The thumb screw *C* is a standard screw in many shops, or may be replaced by a set screw.

In the assembly view is shown a punch and die *D* and *E* clamped together in order to scribe the outlines of *E* upon *D*, illustrating one of the uses of the tool. The proportions shown in the cut, while not claiming to give the greatest strength with the least possible material, will give good service. The boys call the clamp "the ice tongs," and find it quite useful.

Lynn, Mass. CO-ORDINATE.

A peculiar phenomena in connection with a wireless telegraphy station is the formation of light fogs, which seems to be accounted for by the fact that the ether motions produced by the sending station are utilized in electrifying the air, causing condensation of the invisible particles of water vapor into larger drops.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Does It Pay to Write?

This subject has been discussed in the AMERICAN MACHINIST from many viewpoints by many writers. The cash value and the educational value have been referred to, but so far no one has mentioned the diversion obtained. I write over several pen names and it's great fun to hear the things the boys in the shop say about various articles. This writing over a pen name and getting the opinion of the boys on the article is an excellent antidote for swelled head, as criticisms are not always favorable.

I get considerable pleasure from the mere writing and also in traveling from place to place in search of material I get a lot more. There are the men with quaint speech and queer ways of describing things. A young and very green machinery salesman recently told me quite seriously that a certain lathe he handled had "a hollow hole through the spindle."

While on a trip through New England recently I met a salesman. We sat on the same seat in a crowded car. Trade was bad at the time, and he entertained me for awhile with a tale of woe about the difficulty he had in landing orders for tailors' trimmings, bindings, etc., and finished up with the question: "Vat's your line?"

"I don't care to say exactly what my line is, but I will give you an idea of what I do and how I do it.

"I visit various manufacturing concerns, go through the shops and select the material I think I can use, making notes of what I want and asking questions about it at the same time. Then I go to the proprietor or superintendent, tell him what I have selected and ask him to give it to me. As a general thing he does and sometimes I get more than I ask for, as he is reminded by my list of certain things I have omitted."

"Vat! you don'd mean to tell me, dat you don'd *pay* for id! You ged id for *noding?*"

"Certainly I don't pay for it, they always seem glad to *give* me what I ask for."

"Vill you sell me a list of de people you call on? I carry a side line of mining and oil stocks."

"No, I won't sell a list of them, and I want to finish telling you what I do.

"After they give me the material, I take it back to New York to my shop, sort it out and fix it up a little, then I sell it to a concern that sells it to people all over the country and, you will hardly believe me, the people who gave me the raw material in the first place are among the customers of the concern to whom I sell, and they seem often to be more anxious to buy the packages containing their own worked-over material than the packages containing the material I get from others."

"I can hardtly beleef you, aldough you speak in a fery gonvincing manner. Is dere much money in id?"

"Money in it? Why man, there's nothing *but* money in it. Why think of it, I get the material for *nothing* and sell it for at least 12 dollars a *yard;* not a *piece* of 5 yards like trimmings, but a yard—36 inches."

This knocked him out for the time being, but by the time we reached Worcester and I rose to leave, he made a gigantic effort, pulled himself together and thrusting a card in my hand he gasped:

"My gard—if you effer vant a pardtner you vill wridt me und ve vill talk dings ofer."

New York. E. A. DIXIE.

Time Required for Machine Work

An English correspondent inquires regarding the work shown on page 164 of the current volume, and wishes to know if the time given is not misleading owing to the fact that some of the pieces have to be polished afterward in another machine. While this is not absolutely necessary, it is advisable in most cases, but can hardly be called misleading, as machine finishing can hardly be considered as embracing polishing. This can be done on a much cheaper machine, and the difficulty of rechucking is not great when enough pieces are being done to warrant it.

As a suggestion in holding such work as the piston, Fig. 3, the makers of the machine in question would chuck it, bore taper hole, finish outside up to the jaws; reverse the piston holding in soft jaws on the finished end and finish turning the outside.

The valve shown in Fig. 14 was another disputed point, and it is claimed that the time given is misleading because it does not include the brass bushing for the valve seat, etc. This seems unfair in every way and hardly worth considering. The valve body would be held in a valve chuck which could be turned so as to finish the whole piece at one setting.

It was perhaps unfortunate to say that "the surfaces marked *f* being finished in addition to those bearing dimensions" instead of "finished as indicated," but there is hardly an excuse for being deceived even as it is. In all these articles it is the intention to give such times as can be duplicated anywhere with a modern tool equipment and good men.

New York. FRED H. COLVIN.

Home-trained Technical School Instructors

Mr. Dornbirer gets back at me at page 243 on the subject of apprentices staying in the old shop. All of what he says is true, though the citing of instances proves nothing unless it be accepted that "exceptions prove the rule." When he winds up with his statement that some students remain as teachers in colleges, he shows, not ignorance, but a lack of humor, for to one who has seen the lamentably ludicrous antics of these same student-instructors, it is one of the saddest sights that was ever laughed at.

I had contact with a few of these chaps when I was in school. One of them was teaching a course on steam engines and boilers. One of the other students and myself had run up against some real boilers and some had-been engines in vacations. We had the instructor where he didn't dare to answer a question that the rest of the class asked. By playing tennis with him between engine tests (five-minute tests) we got good marks, so it was all the same to us.

I never knew one of these fellows to have the hold on the boys that he should have, no matter how long he stayed on the job. The students get a teacher's pedigree. They know whether he has a swelled head or not, and they know when their teacher is afraid of them. I have recommended a couple of students to try teaching this year, but it was only because I thought they needed the money and jobs were scarce. I shall just as distinctly recommend that they get out of it at the end of their time, and go out and learn something of the world of society and mechanics outside of their own school.

The way professors and instructors are selected for technical schools militates against the success of a student instructor. They are seldom broad-gage men. They are chosen by the number of letters which they can lawfully write after their names: these same letters are given them by other

schools. Every school knows better than to put any great faith in their own degrees. Occasionally a man breaks into a technical faculty who has run up against the world, but for the most part they are not a class of men who realize what it means to back up against the wall and fight for life, tooth and nail. Not having to endure and fight against injustice themselves, through being brought up in an atmosphere tainted only by their own inherent or inherited jealousies of one another, they do not know nor care what justice means in their relations to students. Each one is a petty czar, from whose judgment there is absolutely no appeal. As a class they rule with all the petty dictatorial means that lie in their power.

In spite of all this, I do believe that a school should draft into its faculty more or less of its own graduates; making sure that they have not had too easy a time since graduation. There is a spirit to be found in graduates of five, ten or fifteen years' standing that cannot be expected of either an outsider or a yearling. He comes back, not with a desire to show how much better they do these things elsewhere, nor a wish to tear down everything that has gone before, but with a feeling that he must back up the worth of his own diploma by supporting the policy of his own school, and that he must do his best to advance that policy by every means in his power.

Springfield, Mass. ENTROPY.

Automobile Grinding Work

On page 680 I notice a letter by L. F. C. George, asking for information on grinding. Our plant makes automobile motors only, and we have a number of grinding operations. Our crankshafts are turned 1/32 inch over finish size and are ground to size by a Norton wheel, 1½-inch face, 30 inches in diameter, crankshaft finish size on throws 2¼. They are drop-forged steel and the wheel has given entire satisfaction. The only trouble we had was from chattered crankshafts, and I first thought that the operator had allowed his centers to become loose, but found his wheel glazed instead. After using the diamond the cranks were all right again.

For our small work, such as piston pins, valve stems, etc., we use an M. 46 wheel. Our pistons are turned in one operation on a Gridley piston machine 0.020 inch oversize with piston-ring slots and oil grooves complete, ready for grinding. We use a carborundum wheel on pistons and also for the bore of the cylinders and for cast-iron work generally.

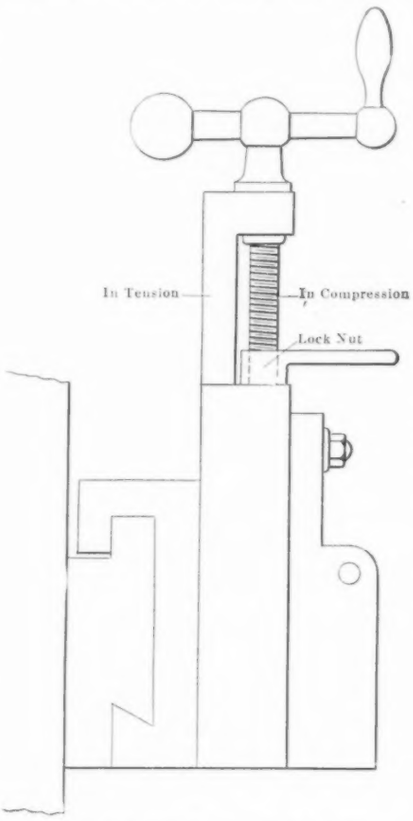
The trouble with most operators, they allow the wheel to become glazed, which prevents the wheel doing its proper work. We find that by using the diamond at the first symptoms of glazing the wheels will do good work.

Flint, Mich. GRINDER.

Accurate Planing to Avoid Unnecessary Scraping

Under the above caption, on page 683, L. F. C. George speaks of a planer tool taking a heavier cut after raising the clapper up and allowing it to fall back into place. About 10 years ago I encountered the same proposition while developing a method for testing the hardness or workability of cast iron, and since that experience pointed out the remedy for as well as the cause of the trouble it may be worth mentioning.

The arrangement for making the tests was to place behind a specially constructed clapper, a device for taking the backward



TOOL BLOCK FOR ACCURATE PLANING

thrust of the tool and recording the pressure of a cut on a strip of paper that moved in unison with the planer table. A pressure diagram was thus secured for each cut of the tool as it was fed across the surface of the test piece. The whole apparatus was made with the utmost care and precision, carefully calibrated, and was delicate enough to register the fraction of a pound pressure at the point of tool. A standard depth of cut of 0.015 inch was adopted as giving pressure within the range of the instrument. With cast iron of various qualities, the pressures with this depth of cut varied from 150 to 230 pounds at the tool point, so that if the pressure varied directly as the depth of cut, there would be a pressure of 10 to 15 pounds for each 0.001 inch of cut.

It was found that with each succeeding cut as the tool was fed across the surface, there was a slight increase in pressure, and since it required an increase of but 0.001 inch in depth to make a difference of 10 to 15 pounds on the diagram, it will be seen that this afforded a very delicate test for a cut of uniform depth. At first it was thought that the difference in pressure was due to the dulling of the tool, but after repeated experiment it was demonstrated that *it was impossible to run a cut of uniform depth across a surface with a tool slide as ordinarily constructed.*

The reason for it is this: There is always a little lost motion between the down-feed screw and the nut in the slide carrying the clapper box. It will not do to have the slide loose enough so that it will settle of its own weight, because then the weight of slide and tool would be the only pressure tending to hold the tool to its work, and no one would expect accurate work with the tool riding on the surface by its own weight and that of the slide. It is, therefore, necessary to tighten up the slide so as to require some pressure of the screw to force it down. When we do this and set the tool down, the screw will be in compression and that part of the swing frame between the top and slide will be in tension, both tending to force the slide lower down (see Fig. 1). In the experiments referred to the slide was set up so tightly that a considerable effort with both hands was required to turn the screw, but this did not lessen the difficulty. A little consideration will show that the compressive force in the screw is resisted by the friction of the slide, and that when the tool is set down at the beginning of a cut these forces are in equilibrium, no matter how tightly the slide is set up. It requires then but a slight jar or vibration of some kind to disturb this equilibrium and cause the slide to settle a little, and this is readily afforded by the jar of the mechanism of the machine, the starting of the tool into the cut, the vibration of the tool itself, the fall of the clapper, etc.

The remedy is to place a lever lock nut on the down-feed screw, as shown in Fig. 1. The slide is worked loose enough so that it will settle down by its own weight, and after the tool is set down the proper distance the slide is locked in place by the lock nut. There can be no movement either up or down of the slide.

W. A. KNIGHT.

Columbus, Ohio.

Wear of Gear Teeth

Referring to the article by E. F. Duncan, on page 273 regarding "A peculiar case of wear in gear teeth," I would say; I have had considerable experience in running and wearing of gears. Mr. Duncan says his gears are wrought steel; the trouble is not in the lubrication, but in running two gears of the same metal, into one another, at that rate of speed which

has proved a failure, in a good many cases. I have seen numbers of cases of the same kind of a wear.

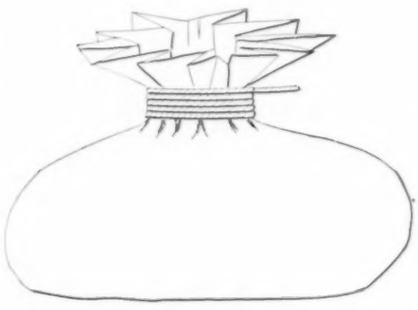
I would suggest this remedy: Try a cast-iron cut gear into a wrought-steel gear, or still better a raw-hide cut gear into a wrought-steel gear and the trouble will cease. The main points are, have them running dead true, have the teeth meshed well and try to avoid running two motors of the same kind at a high rate of speed.

Oshkosh, Wis. ALBERT ROEDER.

Chalking Tracing Cloth

A still simpler method of chalking tracing cloth than that explained by F. W. Harris on page 388, and one which I have seen used in several drawing offices is as follows:

Take a piece of white rag about 9 inches square and place a small heap of powdered chalk in the center, then gather up the corners and sides of the rag and tie them tightly over the heap of chalk so that it forms a bag for the chalk somewhat after the shape shown in the line cut. Then if the face *A* is well punctured by means of a pen point or any other suitable article which happens to be handy, by giving the bag a shake or two over the cloth to be chalked a suitable amount of chalk will escape through these punctures onto the cloth, and it may then be rubbed into the tracing cloth by means of the same bag, the shape of which makes it very suitable for this purpose.



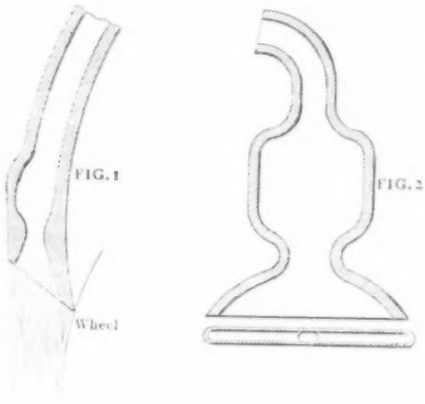
THE CHALK BAG

The reason for chalking the tracing cloth is to enable the ink to flow freely from the pen and adhere to the cloth; this same result may, however, be attained by another method which is just as simple and certainly far cleaner than chalking the cloth, for as Mr. Allen truly says, "chalk adheres to felt," but it also seems to adhere to one's clothes to a far greater extent. If a small quantity of ox-gall be mixed with the ink, it will be found that the ink flows quite as freely, adheres to the cloth and is quite as satisfactory as when chalk is used.

Chelmsford, England. BLUEPRINT.

The Anti-splashing Nozzle

Your article on page 356 on non-splashing wheel nozzle was most novel and had it shown a section it would have been more instructive. I think that water is pumped through piping into the casting, as shown, and that this is cored out larger in diameter, making, in a sense, a reservoir. Then the end is reduced to increase pressure and opened to give a



THE ANTI-SPLASH NOZZLE

little spread, as Fig. 1. An orifice of this class is called a compound orifice and has a velocity

$$Q_a = 1.5526\,Q$$

where

Q = Theoretical quantity discharged per second;

Q_a = Actual quantity.

This increase in pressure would no doubt cause a wire-drawing action, as shown. Some time ago I saw the nozzle, as shown in Fig. 2, and having seen nothing of this shape before I was interested in it. When the machine was started I found that this gave one unbroken sheet of oil upon the job with an absence of splash, and I have tried it in our own works on several jobs with great satisfaction. I think the Bath nozzle works under the same principle.

Manchester, Eng. GRINDER.

Automobile Pins and Cotters

In reading over R. E. Mark's article on automobile design, on page 566, I was reminded of a little kink which I picked up some time ago. It is probably not new to a good many of your readers.

With regard to his lever pins, with the square ends, I think if they were rounded as he suggests, it might save some sweat and cusswords, but I am afraid the automobile concerns will not take time to remedy this. I would suggest he use his file the next time he has that pin out. It may be hardened, but I doubt it.

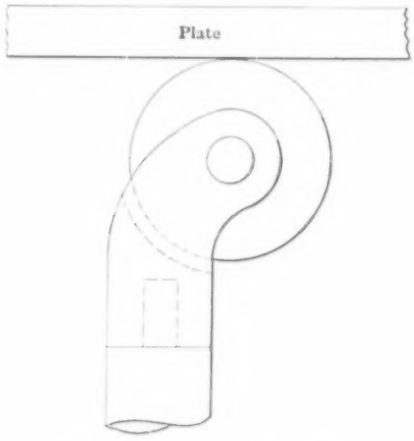
With regard to spring cotters, I always straighten, as near as possible, with the pliers, and then holding the two legs together, with two fingers, and resting the points on a stone, or other convenient hard substance, hit the head of the cotter a smart blow with a hammer, wrench, or even another stone. This will do the business, and his pin points will meet as well as ever.

A pin with different length legs may be convenient, but I know from experience that when such a pin finds its way to the hands of an average erector he will drop it in the pit.

Waukesha, Wis. W. F. STEEL.

The Use of Balls on a Drill Press Table

In the article that our friend Dixie has on page 461, I am reminded of the frequent use of cast-iron balls, such as he mentions, for the runways of big core ovens. His mention of the tables of countersinking machines in shipyards reminds me of another scheme for holding large plates which is quite common around plate mills and near heavy shears, but I have not seen any in a whole lot



CASTER FOR STEEL PLATE MILL

of places where it could be used to advantage. This is a device very similar to the ordinary caster that is used for furniture. It is, however, turned upside down and has a wheel of 5 or 6 inches in diameter. The rest of the proportions are similarly large. A lot of these are stuck in the floor in the neighborhood of the machine and stand level with the table. Being firmly fixed and about 2 feet apart, the plate can be pushed over them with comparative ease for a considerable distance in any direction, the workman walking between these uprights. The illustration shows the scheme.

Cleveland, Ohio. R. I. C.

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Cooperative Technical Education for Apprentices at Bridgeport, Conn.

As the result of an address by M. W. Alexander before the Manufacturers' Association, of Bridgeport, last May, a committee on technical education was formed which has recently brought in the following report:

A plan of coöperative technical training for apprentices has been worked out to meet the needs of the manufacturers as made known at a general meeting held early in the year. This course of training is practically identical with that which has been developed with such great success by M. W. Alexander for the General Electric Company at Lynn. But one difference marks the plan as evolved here. The more than $200,000 invested in equipment and buildings at Lynn will be saved to Bridgeport until such time as the manufacturers or the board of education are in a position to establish a separate institution to meet the situation.

More in detail, apprentices will pursue their shop work as at present in the factories where they are under contract. The class-room work which forms the keystone of successful performance at Lynn, where it is given in a central building over a mile distant from portions of the plant, will be given here in the Y. M. C. A. building, to which the students will proceed for a two-hour period for either three or five days a week as the manufacturer may elect. These two-hour periods as at Lynn, may be assigned to commence or terminate with the regular hours of work at the factory. This affords a minimum of lost time in going to or from classes, as students will do this on their own time in one direction.

The classes will be in charge of competent instructors especially qualified, and engaged solely for this work. Owing to the lateness of the season, it has become necessary to limit the course for the first year to 30 weeks instead of 42, as adopted at Lynn. In view of the somewhat shorter season, it is obvious that the five-day plan is desirable, if not essential, to a fair test of the system during the first year. The shop work should be assigned to the charge of some capable employee already on the factory pay roll, who shall supervise the work of the apprentices under his care, and familiarize himself with the general lines which the instruction will follow.

The cost to the manufacturer will be a natural charge for the development of apprentices. At Lynn, this has turned out to be—in dollars and cents—one of the most profitable departments of the works, as the increased value of the apprentice from day to day as an employee in the manufacturing departments much more than offsets the expense. Here the instruction expenses will be divided among those making use of the system, and for the first year the charge will be approximately $20 or $30 per apprentice, according as the three- or five-day-per-week sessions are used.

Solid or Observation Stops

There is a difference of opinion in regard to the advantages of solid or observation stops in machine tools, if it can be so called. We naturally think of a solid stop as insuring the same results in all cases and that a positive stop means that duplicate work is sure to be obtained; and yet when we stop to consider that cast iron is quite elastic, that no two men bring up against the stop with the same pressure and that the same man will not use the same amount of force at all times, we see the argument of the other side. There is hardly a tool that has stops which cannot be sprung or where something will not give a trifle when brought up solidly against it with all the muscle that an energetic operator can bring to bear.

A familiar example of this is the use of the micrometer where different men do not obtain the same readings, owing to the variation in the pressure applied. The ratchet stop was devised to overcome this and insure the same reading in all cases—although even here there is a difference of opinion as to results.

The advocates of the observation stop, which is really the bringing of the proper graduation to a given mark or index, claim that this does away with all springing of parts or straining of metal in any way. The workman simply turns his handle until the proper marks come together and he has gaged his sizes just as well as with the solid stop, or better if we agree with its advocates.

With large graduated disks so that the divisions are not too close together, and with indications so arranged that the operator does not have to remember one or more divisions for different sizes, there is no trouble in bringing the tool to the right place. True it is easy to move it too far and spoil the piece, but this is hardly to be considered by the careful workman, who is just as much interested in turning out good work as though he owned the shop.

All this, of course, applies only to hand-operated machines such as boring mills, turret lathes, etc., and not to automatic machinery, as here the positive stop is not only necessary, but is not open to the objections cited, as the pressure is practically uniform in each case. As in most cases it is more than probable that each plan has its proper field, but it behooves everyone to determine which field his machine is in.

Business Harmony*

By Murray Shipley†

Some years ago, down in the old Culvert street building, we received certain blanks from the State Inspector of Factories. It was our duty to fill them in and state many details of our business. This was neglected, and the result of such neglect was that we soon had a visit from the head inspector, who proceeded to take me to task severely for my neglect. As I was clearly in fault, the only thing to do was to be particularly polite, apologize for my neglect and promise to attend to the matter at once. There was a twinkle in the inspector's eye as he remarked: "If there were no people like you, who neglect these notices, there would be no job for me." Put that down in your note books and see if that doesn't help you many a time when you think things surely do go everlastingly wrong.

You remember the story of the boy who went to the drug store and asked for five cents' worth of salts. While the man was weighing it up he said: "Say, boss, don't give full weight. It's me that has to take it." Let me tell you a few reasons why there is any job for the bosses, and why they sometimes feel like joining the boy in his remark about the salts, "Say, boss, don't give full weight. It's me that has to take it." The bosses' job is to see that the goods produced cost less than the price the market will pay for them.

Starting a Business

The first thing the boss does, if he is a wise man, is to find something of which there is a considerable quantity sold, and about the manufacture of which he is thoroughly well posted. Then he must have, or get, sufficient funds to carry on the proposed business. This means right at the start that much of his capital lies in his brains, and it is largely on belief of his brains, or in other words, his ability, that he can or cannot get the necessary funds. Assuming that he has gotten his funds, then he finds suitable real estate and rents or erects a shop and begins to look about him for competent men. Almost directly in such degree as he shows himself a master in this difficult task of selecting men, will his future success be attained, for the commanding general must have competent officers to carry out his orders.

Now come all those thousand of details, each of which is a factor in his success or failure. In our trade there looms large the designing of the machine, the proper shop equipment, clever jigs and templets and all that physical equipment you know so well.

Now he must think of the commercial end of the business. This means broadly selling the goods and collecting the money. But he must divide this into its hundreds of divisions.

The Selling Force

Let us first consider the salesman. Here comes again that faculty of choosing. He must be a man who can answer your many questions, explain the machine and its capacity and convince you that you ought to buy our lathes rather than those made by our competitors.

He must be of such caliber as to inspire confidence. He is today a very high priced man. His salary ranges from $1800 to $8000 per year, and his traveling expenses usually amount to as much more. He must turn to account every opportunity that presents itself, but at the same time must know when to quit. He must not be like the little girl named Marjorie, whose mother had become greatly interested in domestic economy. Several courses at a fashionable cooking school had opened their eyes to the fact that nothing should be wasted. The servants were daily, almost hourly, admonished not to throw away any material which could be re-cooked or hashed or served up in some sort of edible manner. Of course the child heard the continual admonitions against waste so freely given.

Now Marjorie possessed a little kitten, which for some reason or other refused to continue the struggle for existence, turned up its paws to the daisies and died. Marjorie appeared before her mother carrying the sad and drooping remains. "Mamma," said she, "just see what I've found thrown away now! A perfectly good kitten."

Then this supposed manufacturer must find good selling agents or machinery merchants in the large cities all over the world. These are a very important factor, and to make good they must be hard workers and loyal. Such agencies are built up from small beginnings and develop year by year, and can never be found just right or ready. These agents cannot make a reasonable profit unless they get for themselves one-eighth of the price the retail buyer pays. They have their stores, their salesmen, their stock to carry, and many other expenses.

Advertising and Traveling

Then comes the advertising expense. We pay the various trade papers over $5000 per year for advertising. Such a catalog as our last one, S, cost us about $6000, added to which is the cost of the time spent upon it in the office and engineering departments, which probably amounts to $2000 more. Our circulars are another very considerable item. Our exhibits at railway conventions and great expositions, etc., etc., simply swallow money.

Then the traveling! Do you realize that one of your bosses spent three months this year at one stretch traveling, and the other one two months on one trip, building up our selling agencies? And in addition each one is traveling week after week, spending night after night in illy ventilated cars and separated for long periods of time from his family. Don't forget that nothing sells itself! Even Lodge & Shipley lathes have to be explained, demonstrated and the sales of them pushed in the most energetic and intelligent manner possible. Right here is a place where many a business succeeds or fails.

Responsibilities of the Bosses

Then take the buying. A bad mistake here might easily render all the other efforts useless and unproductive. Take the correspondence! A letter couched in words which were not well chosen might so offend as to cost some big order or even an agency arrangement.

My appeal to you is to give the bosses credit for hard work and intelligence. Lend them such assistance as you reasonably can in carrying on this business, which supports and makes a livelihood for you and for us.

Harmony Leads to Success

Unquestionably you do in your daily work, but you can, I think, do more and with little or no trouble. First, let us work in harmony. Don't have the idea that our interests are different. They are not. As we succeed, so do you. It was only 10 years ago that we moved into this, then new, shop with 92 men employed. I believe that in less than a year we shall have employed considerably over 500 men, and within two years probably 700 men. Isn't that success for you? Please remember that in a shop growing so rapidly the chances of advancement are much greater than in a shop that is not growing. If you see something wrong, set it right. For instance, when the timekeeper comes to you for your time, have it ready for him so he can pass on and attend to his job and you can attend to yours. We don't ask you to do unreasonable things like the policeman in this story is supposed to have done:

Just before the excavations were begun in Park avenue, New York, for the underground tunnel, a policeman was attracted by the peculiar actions of a Hebrew, who, with a bag of clothing over his shoulder, was searching in the gutter for something.

"Lost anything?" asked the policeman.

"Ah, my tear frent," was the reply, "I am ruined! I have lost a tventy tollar cold piece, and it rolled into the cutter."

For some time the officer assisted in the search, but all in vain.

*Address at the opening of a new addition to the plant of the Lodge & Shipley Machine Tool Company, Cincinnati, Ohio, November 21, 1908.

†Vice-president and secretary, the Lodge & Shipley Machine Tool Company.

"Well, well," said he to the distracted man, "I shall be on this beat until the morning and as soon as it is light I may find it. If you come back tomorrow night maybe I shall be able to let you have it."

When the peddler got home he found the piece of gold within the lining of his vest pocket, and so did not trouble to keep his appointment with his friend, the policeman.

One evening about two weeks later he passed the spot where he had met with his supposed loss. A great change had taken place, and the big ditch for the underground railroad was very deep. Catching sight of the policeman he accosted him, and said:

"Mine frent, you have not found that tventy toller cold piece? Eh? No?"

"No," was the reply.

"Vell," came back, "if you don't find him pefore next Tuesday, you needn't dig any deeper."

The Employing of Labor

The question of employing labor is something like this: If you bought a piece of real estate for $1000 that was worth only $500 you could only expect to lose money. Just so, if we pay for services we do not get we will all, you and us, be out of a job and that right soon. Don't be afraid that you will give us more than we pay you for. Do you remember the panic of 1893? The slack times of 1897 or 1898? The very dull times of 1904? And here we are again in 1908, emerging from more than a year's bad business. Think of the losses sustained during such times by employers who keep part or all of their forces employed. No man in the employ of this company has had his rate of pay per hour reduced during the past year. When we get back to good times, don't be grouchy because you think the bosses are making some money. If they did not make some in the good times, how could they keep you employed in the bad times, and especially at "good times" rates of wages such as you are enjoying? It is imperative that the good years shall earn sufficient profits to offset the losses made during these bad times and something besides. So when the good times come, remember that not one shop in ten but that loses largely in the dull times, and that it is for your welfare to provide you employment at all during the hard times, that the shop shall prosper during the good times. But I must stop with just a few words more, or I shall be like Sir George Warrender, who was once obliged to put off a dinner party in consequence of the death of a relative, and sat down to a haunch of venison by himself. He said to his butler, while eating:

"John, this will make capital hash tomorrow."

"Yes, Sir George," replied the servant, "if you leave off now."

Loyalty

There is no quality more appreciated by an employer than loyalty, and no quality that more quickly opens up avenues of advancement; and let me add, that the worst of men is not more despised than the brainiest person if he be disloyal.

Don't think you do all the hard work. Don't think the bosses have an unmitigated snap. Don't think that the bosses are anything but "humans," and have their own cares and heart burnings, and have as well sympathy to extend. Finally, don't forget that in this great and glorious country of ours any honest, hard working man with good brains can—thank God—as have thousands heretofore, get to be a boss himself.

Annual Meeting of the Mechanical Engineers

A Digest of the Papers and Discussions Presented at the Annual Meeting of the American Society of Mechanical Engineers, Dec. 1 to 4, 1908

EDITORIAL CORRESPONDENCE

The 29th annual meeting of the Society of Mechanical Engineers was held from December 1 to 4 in the Engineering building, in New York. The address of President M. L. Holman on "The Conservation Idea as Applied to the American Society of Mechanical Engineers" contained many valuable statistics and suggestions for engineers, manufacturers and citizens generally.

John Brashear, the well known astronomer and instrument maker of Allegheny, Penn., was made an honorary member of the society as an appreciation of his great work along scientific lines, after which he gave a talk on Photography of the Stars, illustrated by lantern slides that not only showed more stars than we ever dreamed of, but also the forming and the destruction of heavenly bodies that is constantly going on, unknown to all of us who are not careful students of astronomy.

Wednesday Morning Session

A short business session preceded the taking up of professional papers, at which Secretary Rice read the report of the tellers for the recent election. One hundred and ninety-one new members were added to the society's membership as a result of the membership ballot. As a result of the ballot for officers for the ensuing year, the important offices of the society were filled as follows:

President, Jesse M. Smith; vice-presidents G. M. Bond, R. C. Carpenter, S. M. Whyte; managers, H. L. Gannt, I. E. Moultrop, W. J. Sando; treasurer, Wm. H. Wiley.

President-elect Smith was escorted to the platform, welcomed and introduced to the meeting. His remarks in response touched upon the responsibility of the official members of the society.

The first professional paper, entitled The Engineer and the People, was presented by Maurice Lewellyn Cook. Mr. Cook pointed out that many present-day conditions, among them the broadening of human knowledge, the recognizing of the necessity for coöperation, of forcing the engineering profession and the individual engineer to take a more direct interest in public affairs. This is especially true of matters that involve engineering for their consideration or solution. A corresponding change is already in progress in other professions, notably so in the medical profession. If engineering is to take full possession of the field which it should occupy, and which the public is willing that it should occupy, a greater effort must be made to enlighten the public as to the object and achievements of engineering. More effort must be put forth along lines of purely public interest, and every opportunity must be given the public to cooperate with the engineer. To execute this general policy, the appointing of a standing committee was suggested, to be known as the committee on relations with the public.

Discussion was animated, and from so many sources that it is impossible to even mention all of the speakers who took part. The gist of all of these discussions, however, was approval of the broad principles and suggestions outlined in Mr. Cook's paper. Formal action was taken by means of a resolution proposed by Mr. Swazey. It reads: Resolved that we recommend to the council the appointing of a professional committee to investigate, consider and report on the method whereby the society may more directly coöperate with the public on engineering matters and on the general policies which should control such coöperation. This resolution was unanimously passed.

The second paper of the morning was The Present Status of Military Aëronautics by Maj. George O. Squier, of the Signal Corps of the United States Army. This paper is undoubtedly the most thorough review of the subject of military aëronautics that has ever been presented

before an American engineering society. It discussed in great detail the successful military dirigible balloons of Europe and of America, and sets forth general considerations which govern the design of such balloons. The aëroplanes of various types were then taken up, including the Wright, Herring, Farman, and others. These descriptions were followed by general considerations governing the design of aëroplanes. Consideration was then given to the relations between ships in air and in water, and as an appendix the United States Signal Corps specifications for heavier than air flying machines and for dirigible balloons and an extensive bibliography.

This paper was received with enthusiasm, hightened perhaps by the success of America in the field of aëronautics as exemplified in the work of the Wright brothers. Discussion was contributed by Professor Humphreys in which he called attention to the information that the weather bureau is now publishing, which will be of value to aëronauts, and of the vast store of knowledge which has already been collected in regard to air currents. Doctor Brashear and George L. Fowler spoke of the pioneer work that was done by Professor Langley of the Smithsonian Institution. The value of Professor Langley's work has undoubtedly been underestimated, due to a large extent to the failure of some of his models.

Wednesday Afternoon Session

The session of Wednesday afternoon opened by the reading of a paper on A Method of Obtaining Ratios of Specific Heat of Vapors, by A. R. Dodge. This paper is supplementary to one presented by the author before the society two years ago, and is the outgrowth of the discussion of that paper. The method involves the use of the throttling calorimeter, the object of using this instrument being that it does away with errors which are known to be included in the standard steam tables. The paper was discussed by Prof. Peabody, who gave his indorsement of the throttling calorimeter for this purpose, saying that it involves a marked advance in the technique of the subject.

The second paper of the afternoon was by Dr. H. N. Davis on the Total Heat of Saturated Steam. The author begins by paying a tribute to the genius of Regnault as shown in his classic experiments on the properties of steam, which are still the standard, although over 60 years old. These tables are now known to contain errors, and it is the object of the author to correct these errors for the total heat of saturated steam by working backward from other observations which are now on record. The discussion was highly complimentary to the paper which was characterized as of the highest order of importance, and subject to acceptance as correct.

The session was concluded by the reading of two papers by C. R. Weymouth, on Fuel Economy Tests at a Large Oil-burning Electric Plant and on Unnecessary Losses in Firing Fuel Oil. The papers relate to an oil-fired plant using reciprocating engines, located near Los Angeles, Cal., the economy of which, as shown by the test, is very high, and on the results obtained the author makes comparisons between the reciprocating engines and the turbines, which are unfavorable to the latter. This conclusion was sharply criticized in the discussion as unwarranted, the criticisms being directed to the fact that the plant was tested as a whole, with the result that it is impossible to determine whether the economy found is due to the boilers or the engines, and it was pointed out that for several reasons the obtainable economy of oil-fired boilers is materially higher than that of coal-fired boilers, and the economy found was attributed to the boilers rather than the engine.

Wednesday Evening Lecture

The popular lecture of the meeting was on aëronautics and was given by Lieut. Frank P. Lahm, of the Signal Corps of the United States Army. For many years Lieutenant Lahm has experimented with dirigible balloons for war purposes, and has participated in several international balloon races, winning the James Gordon Bennett cup in 1906. His lecture was fully illustrated by interesting lantern slides and moving pictures, showing the balloons that have taken part in international races, the war balloons of France, England, and Germany, and several of the well known aëroplanes. The seating capacity of the auditorium was taxed to the utmost by an enthusiastic and appreciative audience.

Thursday Morning Session

Thursday morning the following papers were read before the society: Efficiency Tests of Milling Machines and Milling Cutters, by A. L. De Leeuw; Development of the High Speed Milling Cutter with Inserted Blades for High Powered Milling Machines, by Wilfred Lewis and Wm. H. Taylor; Metal Cutting Tools Without Clearance, by James Hartness; Interchangeable Involute Gear Tooth Systems, by Ralph E. Flanders. The discussion of the latter paper was continued after luncheon and was followed by a paper on Spur Gearing on Heavy Railway Motor Equipments, by Norman Litchfield. The first and third papers mentioned have already been published in full in our columns.

Each paper drew out considerable discussion. Following the reading by Mr. Lewis of the paper on the development of the high-speed milling cutter with inserted blades, the question of lubricants for cutters was brought up and in this connection Fred W. Taylor stated that the best lubricant for cutters was cold water with enough soda or oil therein to prevent rusting of the machine. He said that with the high pressure with which the cutting edge was held against the work in heavy milling operations there was no possibility of the liquid being carried between the cutting point and the material, hence the sole office of the liquid is the carrying off of the heat. Other speakers disagreed with him on this point and referred to the well known fact that cutting tools supplied with lard oil, soda water or other lubricants produce a smoothly finished surface where with the tool operated dry a rough surface is left on the work; the difference in the character of the surface being undoubtedly due to the effect of the liquid as a lubricant rather than as a cooling medium alone. Reference was also made by one speaker to the practice in drawing tubing where with the heavy pressures required in passing through the dies the lubricant used is an important factor in the production of satisfactory work. He stated that the results varied with the nature of the lubricating material and that if a lubricant could be made to follow metal passing through dies under the heavy pressure necessary for this kind of work it would seem reasonable to expect it could be carried by the edge of a cutting tooth into a piece being milled.

Oberlin Smith, in discussing the cooling of tools mentioned some interesting experiments conducted by him several years ago with liquid air as a cooling medium. The results then obtained indicated that very high cutting speeds were possible with ordinary steels when cooled in this manner, but the problem of supplying the liquid air to the tool involved too expensive an equipment to warrant the adoption of this method of cooling tools in general shop operations.

In the discussion of Mr. Flanders' paper on Interchangeable Gear Tooth Systems, it was brought out that gear-cutter manufacturers have always been adverse to disclosing the true forms of the tooth curves on their cutters, and L. D. Burlingame, speaking along this line, suggested that the determination of the tooth forms best suited to the needs of various classes of gear users could properly be left to the cutter makers who for years have been dealing with these problems. Wilfred Lewis and others commended the work of the author of the paper in bringing together important data relating to gear-tooth forms, and upon a motion made by Mr. Lewis, which was duly seconded and approved by the society, the council was asked to appoint a committee to investigate the question and recommend a system of interchangeable involute gearing.

Thursday Afternoon Session

The development of the articulated compound locomotive was described by the paper of C. J. Mellin, of the American Locomotive Company. These engines

really have two power units, one fixed to the frame of the locomotive and the other in the form of a swinging truck having its own cylinders and driving wheels and obtaining steam through ball-jointed steam pipes. The largest of these yet built weighs 410,000 pounds, all on the drivers, and distributed over 16 wheel contacts with the rail.

The "Liquid Tachometers," as described by Amasa Trowbridge, have been developed by the Veeder company, both for automobile and locomotive uses. The liquid is forced up the tube by a fan, the effect being the same for a given speed.

The paper on Training Workmen in Habits of Industry and Coöperation, by H. L. Gantt, continued the discussion on methods of inducing men to do their best by the use of the task and bonus system. This is a combination of both day and piece work, and has the advantage of so interweaving the net results as to make every worker in a measure dependent on the good work of all the rest. This gives every man an incentive to not only do his own work well, but to see that his fellow workman does his as well. By this system not only the workman, but the foreman gets a bonus on the amount and quality of work turned out, so that the foreman helps the man who might otherwise be a drag on the rest. This is also offered as a solution for the difficulty in training men for different kinds of work.

Mr. Gantt's paper evoked much comment, all of which was favorable to the work accomplished, particular stress being laid on the humanitarian point of view and the methods of working them out in practice. System idolatry was universally condemned. Mr. Sanders called attention to the fact that this was not intended, and did not supersede apprenticeship, but that it helped to train boys quickly to be accurate and rapid. He also showed the advantage of analyzing each operation in estimating, citing an instance where they had taken a contract at such a low figure that the customer thought there must be a serious error, yet they made 40 per cent. on the contract. This was due to carefully analyzing each separate step in making up the cost. The cutting out of unnecessary movements is part of the difference between high speed and haste.

Mr. Emerson suggested a similar training for managers in the habits of logical thought and coöperation, citing instances where it was seriously lacking.

Mr. Higgins was highly pleased with the methods and accomplishments of Mr. Gantt and expressed the belief that the training of these men was in reality training the managers of the future.

Mr. Dodge testified that the Link Belt Company had found the system a great help during the depression, as instead of losing money as expected they had actually shown a profit in spite of the comparatively small output. This he was confident was due to the organization and to the coöperation of their men.

If all the photographers of machinery would take the paper on Industrial Photography, by S. Ashton Hand, to heart, we should have better illustrations and at a much lower cost. The illustration of machinery is not always easy as the lighting is apt to be bad and some of the details in the shadow, but Mr. Hand showed some excellent results taken under adverse conditions and reproduced with no retouching whatever. This is a subject that interests every manufacturer, as much expense can be saved by careful work on the part of the photographer.

The manufacture of salt by the evaporation of salt water is an interesting process and the methods were described in the paper on Salt Manufacture, by George B. Willcox, with illustrations from the plant of the Solvay company, near Syracuse. While the process is simple there are many details to be looked after in gathering the salt and in using material which will not be affected by it.

The Gas-power Section

A simultaneous session of the Gas-power Section was conducted Thursday afternoon which was opened by a discussion of High *versus* Low Heat Values of Gases Used in Engines, by Prof. L. S. Marks. Of formal papers there were two, one on Reminiscences of a Gas-engine Designer, by L. H. Nash, and one on Possibilities of the Gasolene Turbine, by Prof. F. C. Wagner.

Pursuant to a notice which had been duly circulated, a meeting was held in the society's offices Thursday afternoon to consider the formation of a machine-shop section of the society, and a committee was appointed to lay the matter before the council.

A regular feature of the New York meeting, although one which never appears on the program, was the ninth annual dinner of Professor Sweet and his Boys at the Engineer's Club the evening of Thursday. This dinner was inaugurated at a presentation of a watch to Professor Sweet in 1901, as recorded in our columns at the time, and no feature of the convention is looked forward to with so much eagerness by those who are privileged to be present.

Friday Morning Session

The concluding session of the meeting was opened by the reading of a paper on The Physical Properties of Carbonic Acid and the Conditions of its Economic Storage for Transportation, by Prof. R. T. Stewart. The paper is a record of some very complete investigations into the properties of carbonic acid, especially as related to the economics of its storage and transportation, and gives data from which to obtain the minimum weight of the cylinders in which the material is transported. The subject is of importance, because the freight rates are high and most of the freight charges are due to the weight of the containing cylinders. The paper contains also an addendum in which is given an outline of the specifications for these cylinders in Great Britain and Germany.

The discussion referred chiefly to the addendum. The paper proper was complimented in the highest terms, but several speakers representing those interested in the carbonic-acid industry objected to the comparison made between the practice in Europe and here. The industry is now 24 years old in this country, during which but seven or eight cylinders have exploded, out of a total of about 5,000,000 fillings. While there have been no explosions in England, it was stated that cylinders of the weight used in Great Britain would kill the industry here and cause consumers to go back to the old process of manufacturing the gas from marble dust and sulphuric acid. Explosions do occur in Germany in spite of the restrictions laid down and these explosions were attributed to the overloading of the cylinders in Germany—a practice which does not obtain in this country. The small number of explosions in this country, due, it was claimed, to the simple abuse of the cylinders, was held to show that no additional restrictions are here needed.

The second paper of the session was on the Slipping Point of Rolled Boiler Tube Joints, by Professors O. B. Hood and G. L. Christensen. Previous experiments upon this subject have been limited to the finding of the ultimate strength of the joints, whereas these experiments determine also the point at which slipping begins, this point representing a stress which is far below the elastic limit of the material of the tube. The experiments show that the practice of flaring the ends of the tubes is of negligible value so far as initial slip is concerned. Experiments were made upon joints in which a shallow square thread was tapped into the tube hole and these showed a very marked increase in the strength of the joint.

In the discussion Colonel Mayer pointed out that the lowest figures of the table showed an ample margin of security. He stated that the usual cause of leakage is the presence of oil which has a seriously deleterious effect even in minute quantities.

The third paper of the session was on Tests of Friction Clutches for Power Transmission, by Prof. R. G. Dukes, and it gave the results of a series of comparative tests of a number of commercial clutches.

The final paper of the session and of the meeting was on An Averaging Instrument for Polar Diagrams, by Prof. W. S. Durand. The paper describes an averaging instrument for the diagrams made by the numerous recording instruments which are now common, in which the chart made by the instrument is in circular form, its movement being about its center. After passing the usual vote of thanks to those who had been responsible for the success of the meeting, the session adjourned.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

The Manly Drive

The transmission of power between the prime mover and the machine which turns it into useful work, in such a way that the speed of the driven machine can be varied at will has long been a problem for many inventors and many devices have been made for this purpose. These may be divided into two general classes, one which gives speed changes in positive steps, as the stepped pulley, so long and erroneously called a cone pulley, or the gear boxes which are so common in automobiles and are being used so extensively in modern machine tools, while the other type gives an infinite variety of speeds as the friction cone or disks.

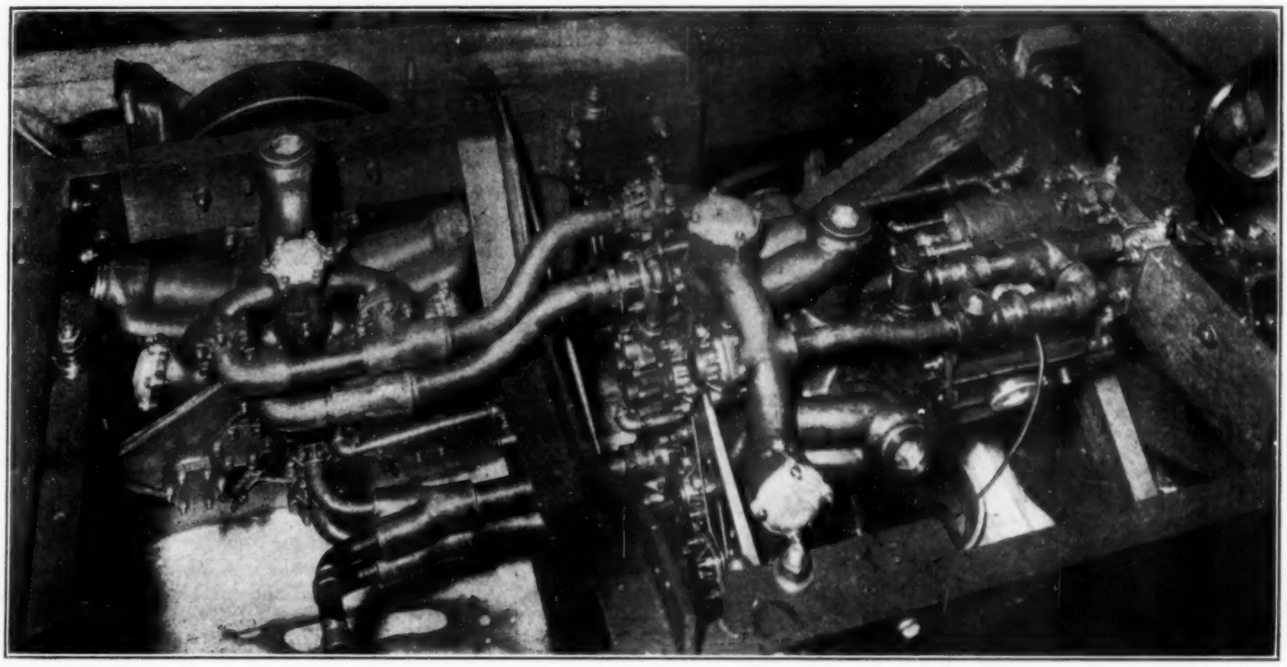
The latest claimant for distinction along this line is shown in the illustration as made for and applied to a heavy motor truck and differs from either of the types mentioned in that it is not a friction device in any sense, but at the same time can vary the speed ratio from zero to maximum or reverse, holding it at any given point.

The device consists of a five-cylinder pump and one or more, two in this case, hydraulic motors which are practically duplicates of the pumps except that they have a fixed stroke at all times. The idea itself is not new, having been tried by Cooper & Hampton, of Minneapolis, some sixteen years ago in connection with electric cars, but as worked out by Mr. Manly it has several novel features and has been given a long series of tests, both in the laboratory and on a motor truck which will show up the weak spots of almost any device.

The stroke of the pump plungers are adjusted by means of two eccentric bushings, one within the other, so arranged that any stroke from zero to maximum may be obtained at will. The movement of these bushings is accomplished by power, the operator merely opening a valve, which controls the flow of the oil. When the pump is running full stroke the motor runs at the highest speed, but by varying the stroke of the pump, and with it the amount of oil pumped, the motor speed is just in proportion to the oil that passes through it, so that any speed can be had and maintained by this means. For reversal the pump must first pass through the zero point when the valves change and the oil is simply pumped into the opposite ports and pipes. In this way the momentum due to running in one direction is taken up in the device itself so that no harm can be done by reversing as fast as the operator can pull the lever.

The whole interior of the mechanism is filled with lubricating oil so that all parts are under constant lubrication and it has the advantage that, as the pressure increases, more oil is forced between the surfaces. This keeps them separated by a film of oil at all times and tends to keep the friction fairly constant. A safety valve, set at 2000 pounds to the square inch, opens a by-pass when this pressure is reached so that no harm can be done to the mechanism by over pressure. The machine shown is mounted on a rack representing a 5-ton truck and has one pump and two motors, one being shown separately. This is to drive each side independently and do away with the differential gears usually employed. It gives any speed desired from rest to the highest and reverse by the movement of one lever.

As applied to machine tools the pump can be located at any convenient place with the motor direct connected, or both pump and motor can be located below or above the tool and the machine driven by a belt or chain on a single pulley, all changes and reverse being handled by the device. Its control is positive enough to enable threads to be cut by stopping the



THE MOTOR AND PUMP OF THE MANLY DRIVE

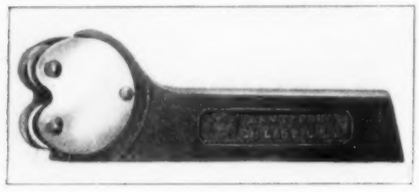
tool and reversing at any desired speed by the controller handle.

While we have no efficiency tests at hand, the prony brake readings, compared with the electrical current which was going into the machine showed a trifle less than 15 per cent. loss. This is, of course, aided by the fact that the whole mechanism is flooded with oil under pressure at all times, insuring the best possible lubrication.

This is built by the Manly Drive Company, 17 State street, New York City.

A Nurling Tool

The illustration shows a self-centering nurling tool which has been brought out by the Armstrong Brothers Tool Company, Chicago, Ill. The nurls are hung in a forging which rocks in a seat in the



A NURLING TOOL

body of the tool, allowing the nurls to center themselves on the work, thus compensating, within certain limits, for any variation in the hights of the tool posts of the lathes in which it may be used. The nurls are made of tool steel and all other parts are drop-forged or bar steel hardened.

Machine for Cutting to Any Outline

The machine described below is specially constructed to cut metal sheets into any desired shape: templets, sweeping boards for foundries and all kind of curved shapes required in everyday shop practice.

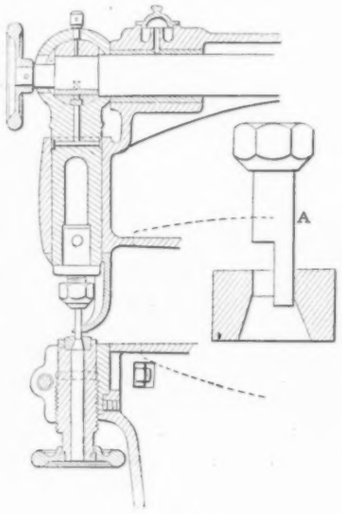


FIG. 2

DETAILS OF PUNCH

It is not designed for duplicate work, but is essentially a machine to replace the hammer and chisel, which have been necessary when only one or two pieces of a similar shape have been required.

The machine runs at high speed, 300 revolutions for the No. 1 machine and 250 revolutions for the No. 2 machine, and is furnished with a punch of a special shape as shown. The cutting edge of the tool is at the left and the back is prolonged to act as a stay. The cutting edge can be set in any direction to suit the work. The stroke of the machine is

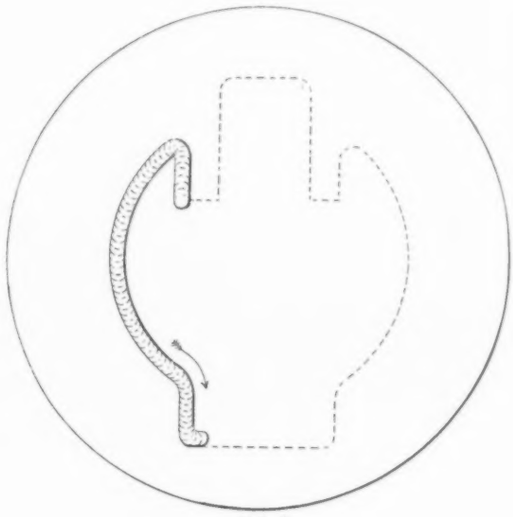


FIG. 3

SAMPLE OF WORK CUT OUT

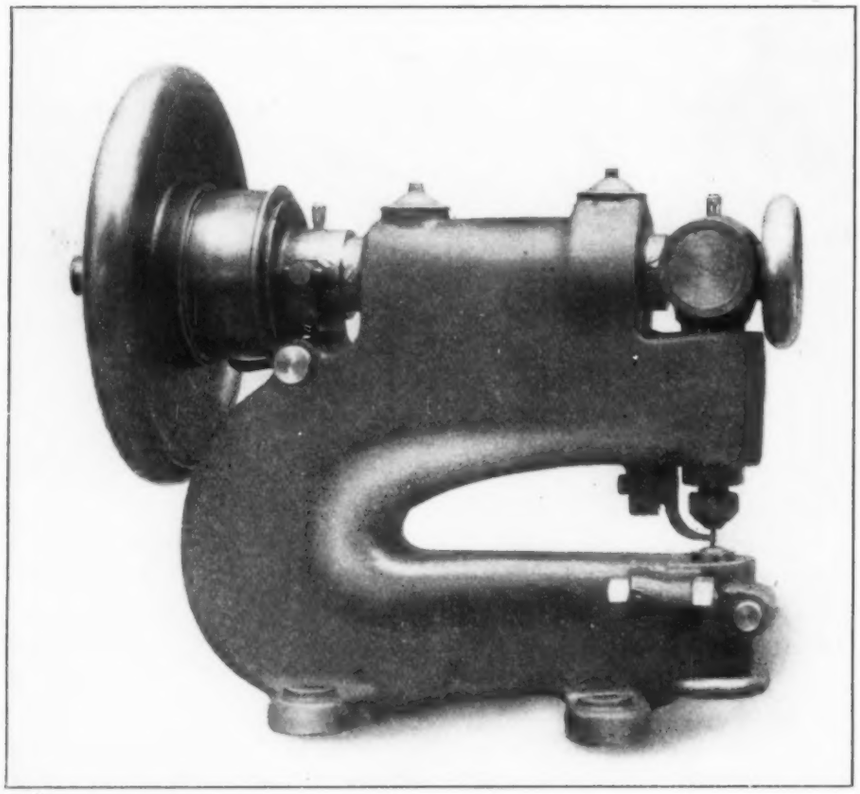


FIG. 1. PUNCH FOR CUTTING ANY SHAPE

slightly greater than the thickness of the piece to be cut and the movement is obtained by an eccentric motion as shown in Fig. 2, the whole arrangement being of circular construction.

The end or tail of the punch of the machine works in a die which is placed in the anvil of the machine just below the punch, the tail being long enough to work up and down in this die throughout the stroke so that it affords a very efficient stay for the punch. The die can be raised and lowered by means of a screw to enable the operator to pass a sheet of metal under the punch, and so he may begin to cut in a hole in the middle of the plate.

The groove left by the punch acts as a guide and the operator has simply to place the plate under the punch and turn it slightly in pushing to obtain any desired shape. After a few minutes' practice a boy can follow a mark and cut out any shape so closely that a smooth file will finish the work.

Fig. 3 shows an example of the work done on this machine. One machine is made especially for automobile frames and similar work. This machine is made by the Société Anonyme des Etablissements Ph. Bonvillain & E. Ronceray, 8 and 11 Rue des Envierges, 17 and 19 Villa Faucheur, Paris.

Horizontal Boring Machine

This boring machine is from a new design recently furnished the Japanese Government. It has a 4½-inch spindle, and can bore continuously to a depth of 32 inches. It is fitted with a No. 6 Morse taper and driven by a 7½-horsepower variable-speed motor through the gearing shown to the vertical shaft behind the hand wheel. The clutch gears above the wheel drive the bar in either direction, and from here transmitted to a sliding shaft *B*.

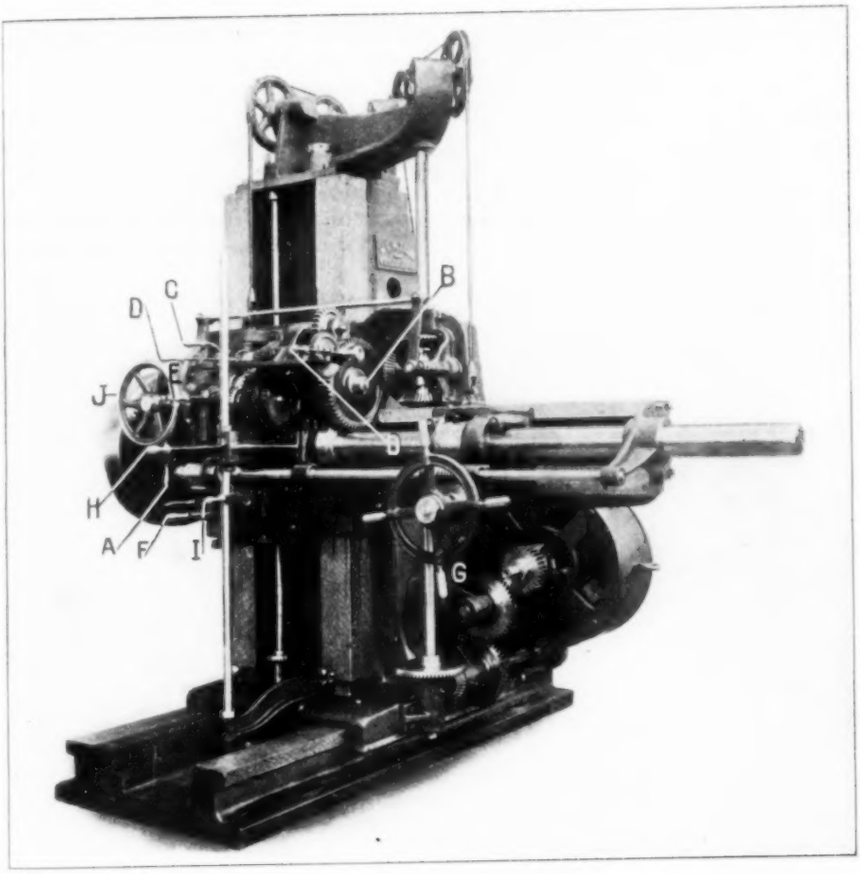
On the other end of *B* is the face-plate pinion, cut from the solid, while the pinion giving the rapid drilling speed to the spindle is shrunk on. The lever *C* slides the entire shaft *B* carrying the pinion in or out of mesh as desired.

With the high-speed gear thrown in any speed between 33¾ and 101¼ revolutions per minute is obtained with feeds of 0.0178 to 0.124. Throwing in the face-plate pinion gives speeds from 10.44 to 31.44 revolutions per minute with feed from 0.005 to 0.038 inch per revolution. Levers *P* control the feed changes, these being operated from two points. Lever *E* controls the direction of all feeds which are independent of the direction of spindle rotation. Wheel *G* gives rapid movement to the bar and wheel *J* is for feeding by hand.

The worm shaft transmits motion through a swinging worm-wheel box controlled by lever *F*, so that the worm can engage either the elevating screw or the vertical feed and the feeds for the uprights. These vertical feeds range from 0.3768 to 8.182 inches per revolution of the spindle and a fast vertical traverse of from 23 to 69 inches per minute, depending on the speed of the motor. The feed of the upright on the bed varies from 0.46 to 10 inches per minute, while the fast movement is from 8 to 24 inches.

The saddle elevation is controlled by a double-throw Carlyle Johnson clutch operated by lever *H*, thus handling the fast traverse of both the upright and the saddle. A rack and spiral gear on the back of the upright give the feeds and fast traverse.

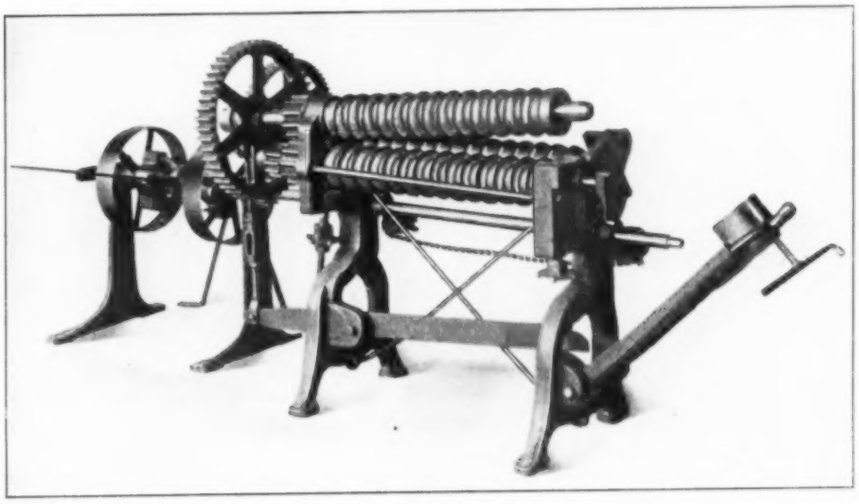
Lever *I* controls a small vertical rod, and prevents both the slow and fast traverse being thrown in at once. It is not necessary to clutch two drives, as it does not matter whether the nut or screw is revolved. The minimum and maximum center distances between the floor plate and center of spindle is 20 and 68 inches, the upright has 48 inches horizontal movement and the face plate is 28 inches over all. This is built by the Newton Machine Tool Works, Philadelphia, Penn.



LARGE HORIZONTAL BORING MACHINE FOR JAPAN

Forming Rolls for Corrugated Material

These are for bending corrugated sheets into tanks, barrels, or for any similar purpose, and have an automatic opening and closing device which is of interest. The hinged end of the top roll is raised and supported, while the opposite end of the bottom roll is lowered at the same time and by the same operation, so as to allow easy removal of the formed plate. This is done by simply turning down the hinge as shown, the cam on the lower end of this acting on the long lever, which has two connections at the other end. One of these raises the upper roll and pulls down the lower roll at the same time. The weight of the rolls is so balanced as to



FORMING ROLLS FOR CORRUGATED SHEETS

make the opening and closing very easy and requiring very little effort on the part of the operator. They are made by Bertsch & Co., Cambridge City, Ind.

Automatic Escape Wheel Cutter

The cutting of escape wheels for watches is a very nice piece of work, as so much depends on their accuracy, and the shape of the teeth does not make easy milling; in fact, it requires from five to seven cuts unless combination formed cutters are used. These are so expensive that this machine has been designed to use simple cutters, up to seven, though all these are not always necessary.

A drawing of the escape wheel, enlarged seven times, is shown in Fig. 3. The cuts are taken in the order shown, 1 and 4, 2 and 3, and 5 and 7 being roughing and finishing cuts, respectively. The heavy lines show the cuts made, and together form the complete tooth.

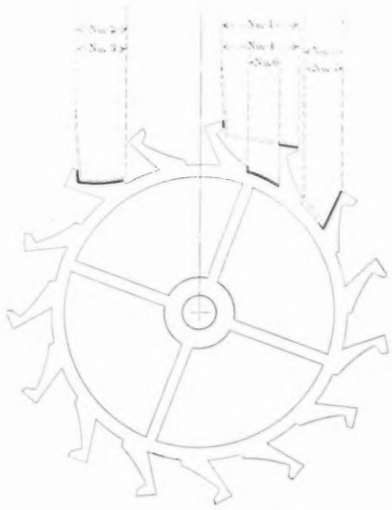


FIG. 3. ORDER OF CUTS FOR ESCAPE WHEEL CUTTER

The wheel blanks are strung on an arbor held in the indexing head *A* in Fig. 1, the tailstock B being swung down out of the way for this purpose. The different cutters are set in their proper position for their cuts, each being adjusted separately, the starting lever *F* is released and the work begins.

Referring to Fig. 5, pulley *W* drives the lower spindle during its cut, the others being idle. The work slide movement and the indexing are driven from the main pulley *V* which drives the worm shaft *R*, this driving the worm wheel above and the cams *K*, *L*, *N* and *M*. Cam *K* operates the work slide *C*, and *L* lifts the cutter-spindle head away from the work for the indexing while cam *M* operates

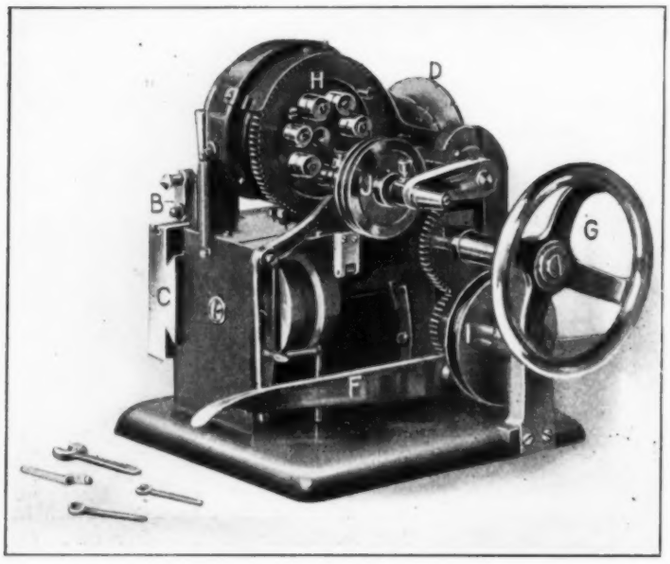


FIG. 1. BACK OF ESCAPE WHEEL CUTTER

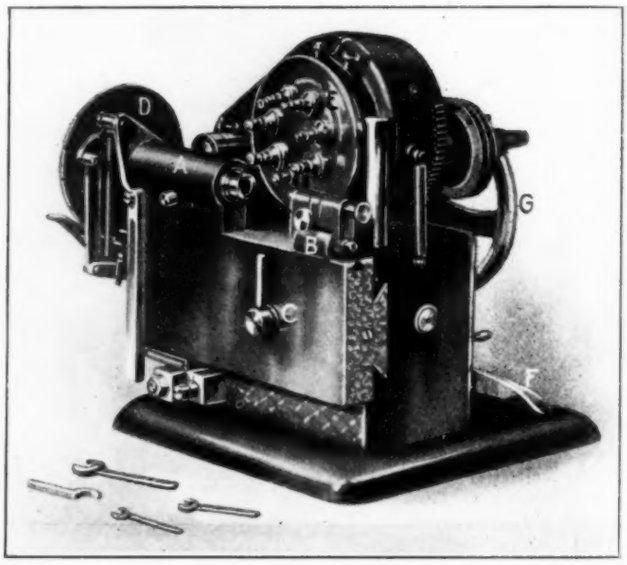


FIG. 2. FRONT OF AUTOMATIC ESCAPE WHEEL CUTTER

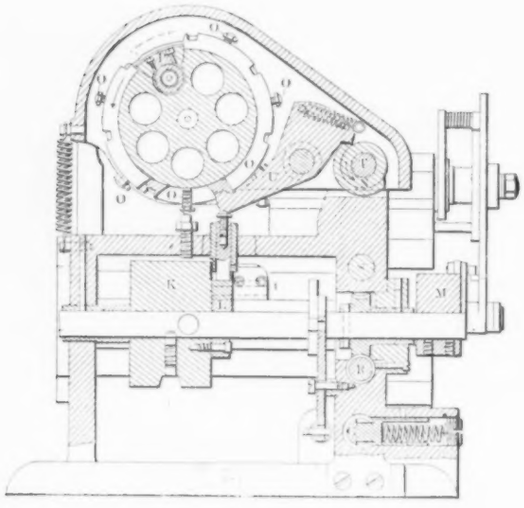


FIG. 4. SECTION SHOWING THE DRIVE

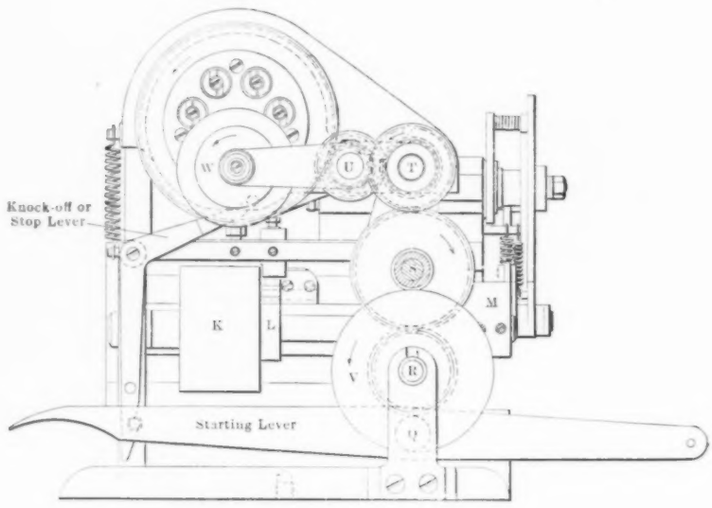


FIG. 5. BACK OF MACHINE

the indexing mechanism at the back. In this way the blank is indexed around for every cutter before the next one is swung into position, and all teeth are cut successively with all the cutters.

When the blanks have been indexed around for the first cutter, a pin on the index wheel engages a positive trip on the other end of the clutch-operating bar Q, which throws pulley V out of contact with the indexing clutch and into the train of gears in Fig. 4, which drives cam N on stud T, lifts pawl V out of the spindle-cylinder lock, revolves the cylinder one notch and brings the next one into position.

Each spindle has its own adjusting stop screw O so that it can be set independently of the rest, and can also be adjusted in and out of cylinder by nut P acting on the spindle quill. The spindle clutch is thrown out while the spindles are being shifted from one position to the other and re-engage as soon as the change is completed.

This continues until the last cutter has made its cut in each tooth of the escape wheel, when the starting lever is thrown up and engages the knockout lever, as shown in Fig. 5. To start again, the lower lever is simply disengaged and the work goes on as before after a new lot of blanks have been put in place in the machine.

Among the interesting details is the roller-clutched hand wheel G, which allows the machine to be turned over by hand for setting and adjusting and yet prevents it being turned the wrong way.

The outer end of the spindle head is guided in the upright shown to insure alinement, in addition to the long bearings on which it swings. This is the latest machine brought out by the Waltham Machine Works, Waltham, Massachusetts.

Thread Micrometer

This micrometer is intended to measure the pitch diameter of screws, and is adjustable for all different pitches. As shown in Figs. 1 and 2, the anvil is mounted in a sliding sleeve in the lower end of the frame, and is adjusted by a micrometer screw which is shown clearly in the line engraving. The anvil and also the micrometer spindle are pointed to fit the angle of the screw thread, or 60 degrees. The angle of adjustment of the anvil, as seen in Fig. 2, is parallel to the side of the thread, or 30 degrees; when the anvil is adjusted sufficiently to bring the point of the anvil and the spindle apart a distance equal to one-half the pitch of the screw the spindle is withdrawn to bring the points in the same horizontal plane a distance apart equal to the pitch diameter of the screw, as illustrated in the detail at the top of Fig. 2. The readings for adjustment for all pitches from 8 to 60 are stamped upon the micrometer frame as are also formulas for finding these quantities. It will be seen that the line of adjustment represents the hypotenuse of a right-angle triangle, one side of which is the depth of the thread, and the base is one-half the pitch of the screw. The micrometer can be made with points to fit other styles of screws as well, but the angle of adjustment must always be one-half the angle of the thread. This micrometer is the invention of Ernest R. Seward, 76 Campfield avenue, Hartford, Connecticut.

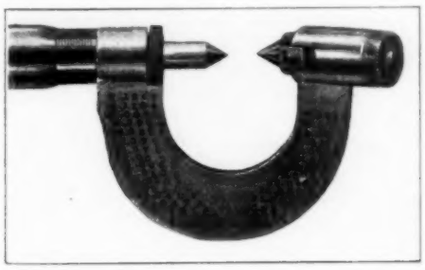


FIG. 1. THREAD MICROMETER

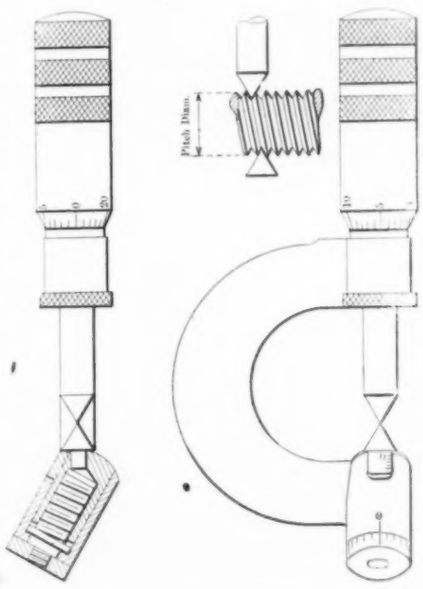


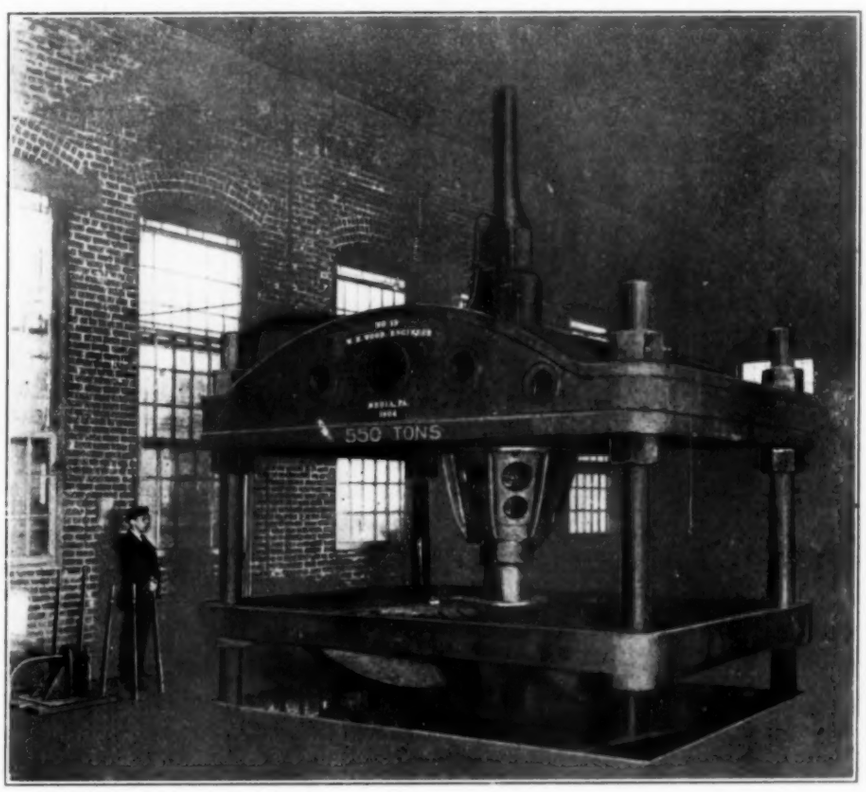
FIG. 2. THREAD MICROMETER

A 550-Ton Flanging Press

This is a press for the heaviest kind of flanging work, built by William H. Wood, Media, Penn. It handles boiler work of all kinds, such as the flanging of heavy locomotive throat sheets, and can turn flanges in both directions as in the back sheets for firebox doors. The table is 9x12½ feet between the columns.

There are several rams aside from the main ram or plunger with its pressure of 550 tons. The internal clamping ram is of 100 tons, the four auxiliary rams 25 tons each, while the ram in the head of the press has a capacity of 160 tons.

The press is controlled by the operating levers, shown at the left, which handle the balanced bronze valves that admit pressure to any desired ram.



A 550-TON FLANGING PRESS

Electric Time Recorder

This recorder registers automatically the occurrence and duration of various operations such as the starting and stopping of machines, the opening and closing

FIG. 1. ELECTRIC TIME RECORDER

of valves, the duration of runs, the passing of trains, etc., it being possible to record several different operations on the same chart and to locate the recorder a long distance from the points at which such operations occur.

Fig. 2 is a reduced cut of a record chart showing complete 24-hour records of the operation of two paper machines. This record shows the time and duration of each break and also the time required to wash the felts and put on new wires.

Fig. 1 shows one of these recorders ar-

FIG. 2. FAC-SMILE CHART WITH TWO RECORDS

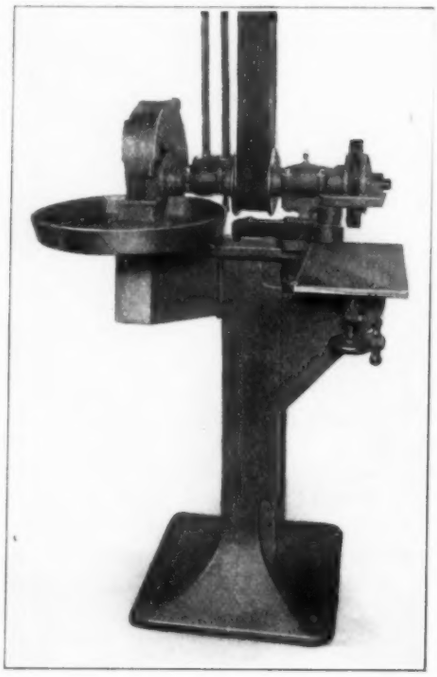
ranged to record operations at six different points. Each one of the six pens makes an independent record, continuously and automatically, and in this way six different operations may be recorded on the same chart. Each pen arm is actuated by an independent electro-magnet and battery-circuit, so arranged that closing the circuit causes the pen to move a certain distance.

These recorders are usually operated by battery, but any convenient circuit may be employed by proper connection. The object whose motion is to be recorded is caused to make and break this circuit through any convenient contact.

This is made by the Bristol Company, of Waterbury, Conn.

A Duplex Grinding Machine

This machine combines a 14-inch water tool grinder and a small dry surface grinder on one column. Large bearings



DUPLEX GRINDING MACHINE

are provided as shown, and the splash pan is of liberal dimensions. Water is fed to the wheel by a small centrifugal pump so that the water supply is constant while the wheel is running, but makes it impossible for the wheel to stand in water. The knee carrying the surface grinding tables has considerable vertical adjustment. The surface grinder can be supplied with a hand feed when desired, but in the illustration only the table-tilting screw is shown. A hand rest is also provided for the wheel over the surface table. This is built by F. H. Otis, 191 Mill street, Rochester, N. Y.

The construction of the Metropolitan Life Insurance building tower, about which there has been so much comment in building and engineering circles, presents some interesting figures. The tower is 680 feet from the cellar floor to the top, 65 feet square, 47 stories high, and weighs 84,000,000 pounds. It contains 1400 windows and required 8135 tons of steel as well as utilizing 40,000 barrels of cement.

Personal*

John L. Walker, formerly auditor for the Buda Foundry and Manufacturing Company, has resigned to accept a position as manager of the "Use-Em-Up" socket department of the American Specialty Company, Chicago, Illinois.

James A. Pratt, who for the past two years has held a position as instructor in machine work at Pratt Institute, Brooklyn, N. Y., has been appointed to a similar position at Williamson Free School of Trades, Delaware county, Penn.

Joseph A. MacLennan, who has been associated with the Link-Belt companies for over 12 years, during which time he has held many responsible positions, has resigned his position at the Philadelphia works to accept the presidency of the Wilmot Machinery Company, of New Orleans.

D. E. Carey, for several years connected with the Western Electric Company, of Chicago, as head of the estimating and piece-work rates department, also as organizer and systematizer of manufacturing departments, has resigned to accept à position as general superintendent for the Aurora Automatic Machine Company, at Aurora, Illinois.

Waldon H. Merrill, formerly connected with the Westinghouse Electric and Manufacturing Company, has accepted a position with the Allis-Chalmers Company, working in connection with the Boston office in looking after power-machinery business for textile mills. Mr. Merrill's former position with the Westinghouse organization was along similar lines.

H. M. Norris, works manager of the Bickford Drill and Tool Company, returned from his three months' trip through Europe in the interest of the company in time to attend the meeting of the American Society of Mechanical Engineers. Mr. Norris' trip was an extended one, and covered practically all of the countries of Europe which offer a promising field for the machine-tool trade.

Elmer G. Eberhardt

We regret to announce the death at Newark, N. J., November 21, of a highly promising member of the younger generation of mechanical engineers, Elmer G. Eberhardt, vice-president of the Newark Gear Cutting Company.

Although but 27 years of age, and but four years out of college, Mr. Eberhardt had established himself as an engineer of a high order of talent. His abilities were marked while still a student, the nickname "General" being given to him by his fellows as a recognition of his leadership as a student. Additional recognition from the same source was his election as presi-

*Items for this column are solicited.

dent of the Cornell Institute of Electrical Engineers and vice-president of the Cornell Society of Mechanical Engineers, while at graduation he received the endorsement of election to the Sigma Xi, an event which comes only to those in the first rank.

He was held in high esteem by a wide circle of acquaintances, who will with us mourn his untimely death.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

Wanted—13" and 20" lathes in good condition. Geo. D. Venable, Aledo, Ill.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machinery built to order. Up-to-date plant. Write Brunswick Refrigerating Co., New Brunswick, N. J.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Machines designed; automatic, special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Wanted to purchase a second hand 24-inch sliding head drill press and small second-hand shaper. State condition, make and cash price. Box 729, AMERICAN MACHINIST.

Automobile manufacturing concern will start operations in the near future; catalogs are desired regarding all machinery, etc., used in automobile factories. Herreshoff Motor Co., Detroit, Mich.

Wanted—Articles to manufacture by contract or will buy patent, tools and fixtures outright, by a manufacturer having a large and well equipped plant and capital. Address Box 564, Erie, Penn.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Cost reducing machinery designed and built. Guaranteed per cent. on investment. Send sample or sketch of work and cost of manufacture. Remington M'f'g. Co., Fitchburg, Mass.

Capitalist, Attention!—Expert mechanic, possessing valuable inventions, wants financial for same. Address, "Inventor," 1639 Gates Ave., Brooklyn, N. Y.

Master Mechanic Wanted—A man with large manufacturing experience of both large and small work; one with drafting and machine shop training and who is a good executive. In answering, state fully your experience in detail, so as to afford one of the best means of passing upon your qualifications. Box 721, AMERICAN MACHINIST.

Here's a Live One—I can put the right people in negotiation with an enterprising manufacturing town of 30,000 people, who want a factory producing boilers for traction engines, and will use the output of a good, large concern. Free site, good railroad facilities, no commissions, no graft,—a strictly business proposition. Great opportunity for those who may wish to establish such a manufacturing business. Address "F. F. B.," AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Superintendency wanted by energetic mechanic with knowledge of costing and organization and a producer. Box 704, AM. MACH.

ILLINOIS

An A-1 patternmaker with wide experience capable of taking charge of shop. Box 718, AMERICAN MACHINIST.

Technical engineer, designing, shop and selling experience on hoisting, conveying and transmission machinery, foundry, railroad and contractors' equipment, heavy machine and structural work. Box 711, AMER. MACH.

MASSACHUSETTS

I wish to correspond with any company desiring the services of a progressive and up-to-date manufacturing superintendent. Box 701, AMERICAN MACHINIST.

Assistant to superintendent or cost accountant, by a technical school graduate who has had seven years' experience as toolmaker. Also held position of foreman. Box 724, AM. MACH.

Superintendent or general foreman, 25 years' practical experience. Prefer large or medium work. Capable, energetic and familiar with use of high speed steel. Thoroughly versed in engine work. Box 726, AMERICAN MACH.

NEW JERSEY

Tool room foreman; any number of men, all branches, all grades. Highest efficiency; best references. "Ability," AMERICAN MACHINIST.

NEW YORK

Draftsman, eight years' office and shop experience; technical education. Box 722, AM. MA.

As superintendent by first class mechanic after first of January. Best of references. Box 710, AMERICAN MACHINIST.

Sales engineer, thoroughly understands general, automatic and automobile machinery. Box 731, AMERICAN MACHINIST.

Young man, at present superintendent, desires position as foreman or assistant superintendent with growing or established automobile company. Box 716, AMER. MACH.

Instructor with experience machine shop practice desires position. Technical or trade school vicinity New York City. References furnished. Box 715, AMERICAN MACHINIST.

Draftsman engineer (28), technical graduate; 4 years practical and 5 years drafting on general and automatic machinery; references. Box 732, AMERICAN MACHINIST.

Draftsman, general and automatic machinery and tools, 16 years' shop and drafting experience, wishes position of responsibility. Best of references. Box 730, AMER. MACH.

Toolmaker with brains and initiative to use them, technical training, practical experience, wants position. Good designing ability, highest references, steady. Box 725, AMER. MA.

The services of one who has had experience with and possesses the knowledge necessary to install apparatus and mix the metals for die castings can be secured by addressing Box 713, AMERICAN MACHINIST.

Machine tool salesman, mechanical engineer, broad experience, several years' selling, acquainted in the East and Middle West, desires to represent reliable concern, salary or commission basis. Box 714, AMERICAN MACHINIST.

Machinist, expert tool and diemaker, 16 years' experience, 5 years' foremanship, ingenious, inventive, labor-saving devices, improvements, wants position as foreman or where A-1 mechanic is desired. Box 717, AMERICAN MACHINIST.

High grade designer; inventive ability, technical, original, resourceful. Fourteen years' practical experience, light automatic machinery, heavy machine tools, hydraulics, electric machinery. Able to take charge and very successful in handling men. "High Grade," care AMERICAN MACHINIST.

OHIO

Manager machine plant, long experience nearly all kinds machinery, engines, etc. Foundry practice. Excellent salesman. Competent take hold any proposition producing first class work, increasing output. Box 727, AM. MACH.

OREGON

Master mechanic with extensive and varied experience in construction and manufacturing in the States, Canada and South America, successful in producing first class work at lowest cost, age 39, desires position where a responsible, high grade, wide awake man is wanted. Box 720, St. Johns, Oregon.

PENNSYLVANIA

Designer, skilled in originating and developing special and automatic machinery and overlooking construction; expert in printing and numbering machinery. Box 728, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

INDIANA

Wanted—Two inspectors, two grinders, six lathe men, two toolmakers, one foreman, four machinists, all for work on gasolene motors. Good wages. Box 666, AMERICAN MACHINIST.

KANSAS

Wanted—Blacksmith for foreman of college shop. Require an expert smith who has ability and patience to instruct students. Salary to start $900.00 for 11 months. Box 663, AMERICAN MACHINIST.

MARYLAND

Wanted—Mechanical draftsmen, thoroughly experienced in heavy machinery and general arrangements. Address, stating experience and salary desired, Ellicott Machine Company, Baltimore, Md.

MASSACHUSETTS

Wanted—A superintendent of unquestioned high character, capacity and ability to take charge of machine shop 200 men or less. Must qualify as an expert modern tool designer and maker. Must be experienced in producing good work, both large and small, at low labor cost. Must know how to handle men. The man who places salary and hours on duty secondary to the business interests of employers preferred. Box 709, AMERICAN MACHINIST.

Piece work cost mechanic. Young man having had experience with scientific figuring of piece work, preferably on press work employing girls and boys. Box 707, AMER. MACH.

MICHIGAN

Wanted—A number of operators on Jones & Lamson, Potter & Johnston and National Acme machines, both day and night work. Must be men of first-class experience. Cadillac Motor Car Company, Detroit, Michigan.

MISSOURI

A large electrical manufacturing company requires a capable, experienced foreman for its indicating instrument department; previous experience indispensable. Apply, giving experience and salary expected. All communications confidential. Box 680, AM. MACH.

NEW JERSEY

Patternmaker wanted to act as working foreman on gas engine work. Must be sober, steady and a thorough mechanic. References, etc. Box 708, AMERICAN MACHINIST.

NEW YORK

First-class toolmaker on rifle tools to take charge of 35 toolmakers. Only experienced men need apply. Location: Canada. Box 706, AMERICAN MACHINIST.

Technical graduate, 28-30 years old, with shop experience in light fast running machinery. Must be good machinist. Man who has the foundation educationally and mechanic to develop into assistant superintendent. Near Philadelphia. "Rotary," care AMER. MACH.

OHIO

Designer wanted, preferably with experience on linotype, calculating machines or printing presses. State references, salary and when available. Box 705, AMERICAN MACHINIST.

Wanted—Thorough, first-class works manager or superintendent for a large machine tool factory. Must have real executive ability and be capable of producing good work and lots of it, to the best advantage—a hustler. Young married man preferred. All correspondence treated strictly confidential. Address Box 720, AMERICAN MACHINIST.

PENNSYLVANIA

Cost clerk, engine and similar work. State experience and salary expected. Address Box 723, AMERICAN MACHINIST.

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A Group of Useful Pipe-working Tools

Pipe Laying-out, Heating, Bending and Testing and the Inspecting of Pipefittings Are Made Easy by Well Designed Appliances

BY PHILIP BELLOWS

The illustrations and descriptions in this article show a few devices for handling pipe. In shops where large quantities of piping have to be bent and flanged to various angles, bends and lengths, difficulty is experienced with, and time consumed by, the use of wooden templets. They are liable to get out of shape and are prone to become knocked to pieces in the shop, largely owing to their ungainly shape and frail construction. Further-more, they give no resistance in the matter of holding the pipe and its flanges. To meet this condition the device shown in Fig. 1 was gotten up in a large plant in New York State to combine the functions of a templet and jig. Since the installation the cost of bending pipe and correctly locating the flanges has been greatly reduced; its operation is an entire success.

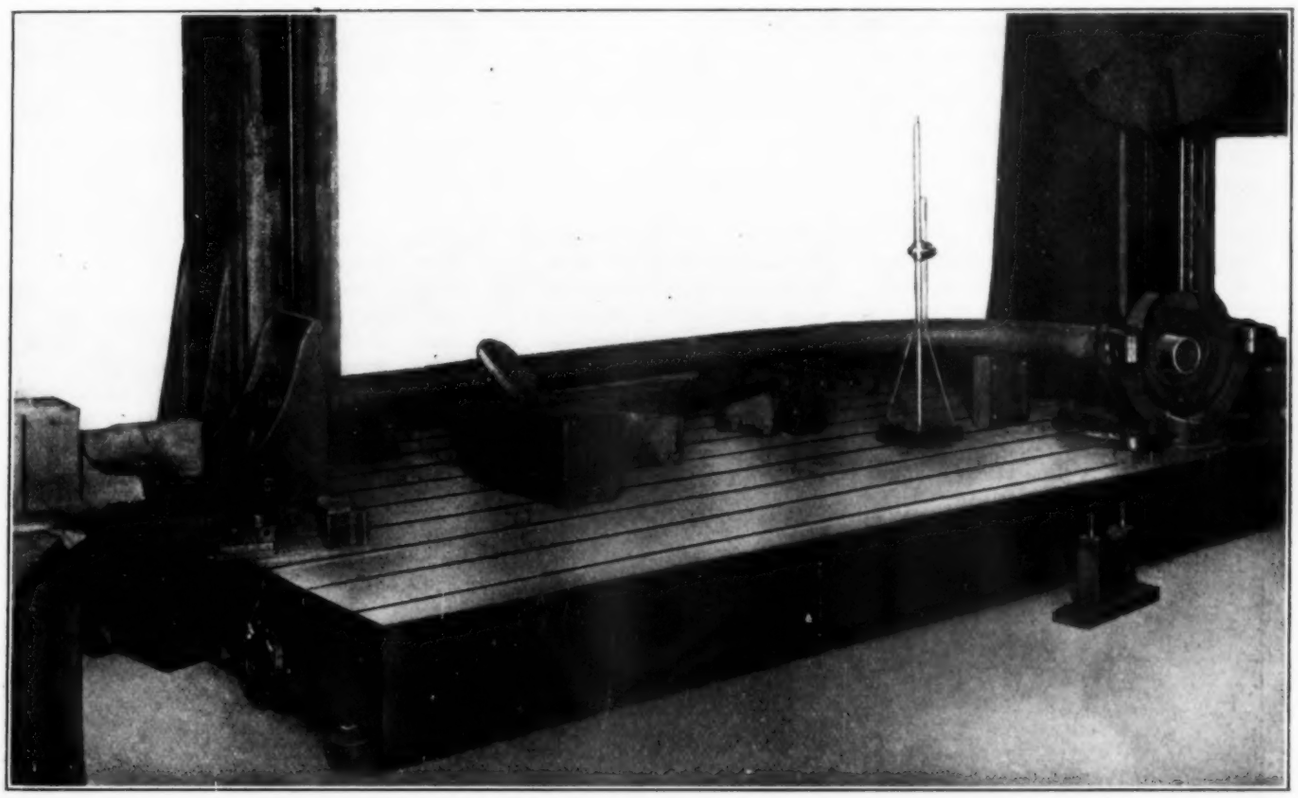


FIG. 1. A PIPE-BENDING DEVICE

The device can be used in conjunction with a large testing plate, or a planer platen, or a boring-mill table. In the shop where it is used pipes 10 and 12 inches in diameter are very common, hence the comparatively large size of the parts here shown. As others may wish to use this article as a basis for a similar scheme for their own use, two sketches are given in Fig. 2 with appropriate dimensions. This device can be used with several sizes of pipe, and would probably fit any size between 4 and 12 inches.

Details of Pipe-bending Jig

The method of using the apparatus is as follows: The parts *A* and *B* are provided with dummy rings; each part has a number of these corresponding with the sizes of pipe that the device is to be used for, though it may be possible to observe economy and use one ring for two successive sizes of pipe. These rings center in suitably bored holes in the front faces of *A* and *B* by means of turned projections, and bolt to *A* and *B* by three bolts in each case. Each ring is provided with bolt holes to match the bolt holes on the pipe flange; it is by these that the latter can be centered. A clearance hole is left through the dummy for the pipe, so that the pipe can be left long and cut off when the job is finished.

We will suppose that a length of pipe must be bent in two different planes, and that the flange at *B* must be set at a 15-degree angle, *A* to be vertical. The pipe is first bent to the correct shape in the horizontal plane, as shown in the plan. Then it is heated at the point where the vertical bending is to be done; meanwhile it is held between *A* and *B* in the manner shown in the dotted lines in the elevation. By using blocks of the correct hight and applying pressure judiciously with U-plates the results are gratifying.

Now the flanges are slipped in place and their theoretical locations are scratched on the pipe; *A* and *B* are set to fair with them in their correct position. The pipe and flanges are then carried to the place where they are to be used and tried in position. If it is found that the flange at *A* will not reach its mate by ½ inch and that the angle of *B*, as shown in the small view at *C*, is 2 or 3 degrees out, one way or another, *A* is moved backward in its slide to the extent of ½ inch and *B* is carefully corrected as to tilt by the amount of its error. The job can now be finished with every confidence that it will be right when done. The flanges are bolted onto their respective

dummies at *A* and *B* with the pipe in its correct position.

With apparatus like this the work of bending and flanging pipe becomes a correct and accurate mechanical operation, leaving no excuse for a pipe to be bolted in place with flanges and bends under strain.

Attention is called to the surface gage which shows in the first half-tone illustration. It is a truly remarkable affair, stands fully 5 feet high, and with its ponderous base and four struts reminds one of a flag pole.

Portable Pipe-heating Furnaces

Fig. 3 shows two forms of a device that might be used very conveniently in conjunction with the apparatus already described. A simple shell of cast steel, shown in section in Fig. 4, is provided with openings for burners; a pipe to be heated is passed through the center of the shell and the flame which can be made intensely hot is caused to play on the precise section that it is desired to heat. By the use of such an appliance as this better work is possible at a smaller fuel expense than is the case with an unconfined flame; the pipe is heated in a short time, and it is much easier to control a bend with the pipe heated locally. This device is adapted for use in connection with gasolene, crude oil, or natural-gas fuels.

A glance at Fig. 4 will show the simplicity of the construction. A lining of fireclay inside the shell protects the casing from burning and also serves as a good reflecting surface to throw the heat back onto the pipe. The general dimensions of the two heaters shown in Fig. 3 are given in Fig. 4. The photograph was taken with full pressure turned on; the flame made a loud roar, yet but little heat escaped around the pipe, even in the case of the far heater, which is shown heating a pipe considerably below its maximum capacity. If any reader of the American Machinist should make one of these devices, it would be well to observe care in the design of one smaller than those shown; that is, to make the width and diameter larger in proportion for the smaller size in order to allow plenty of room for the complete combustion of the

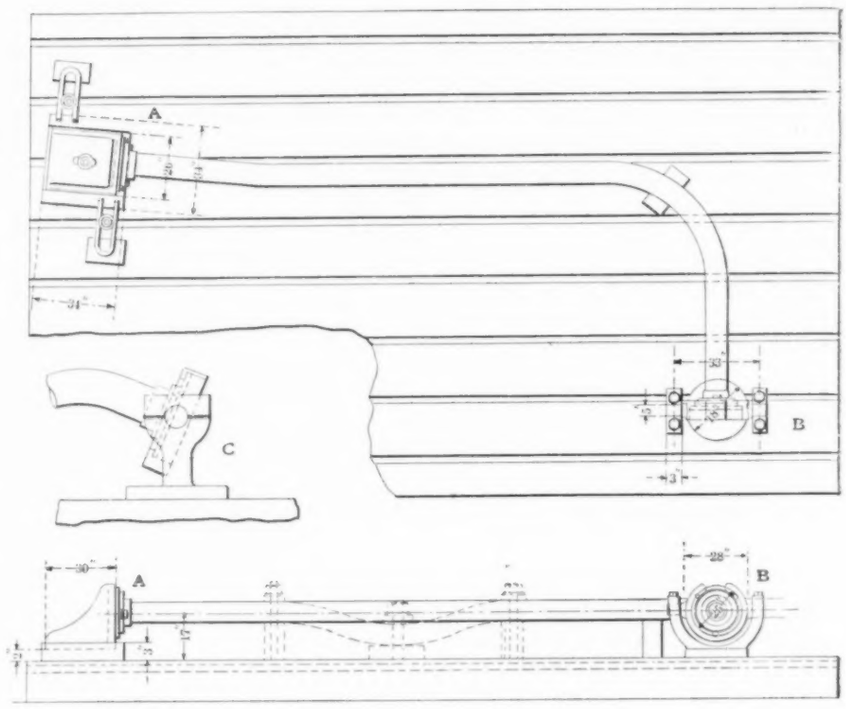


FIG. 2. DETAILS OF PIPE-BENDING DEVICE

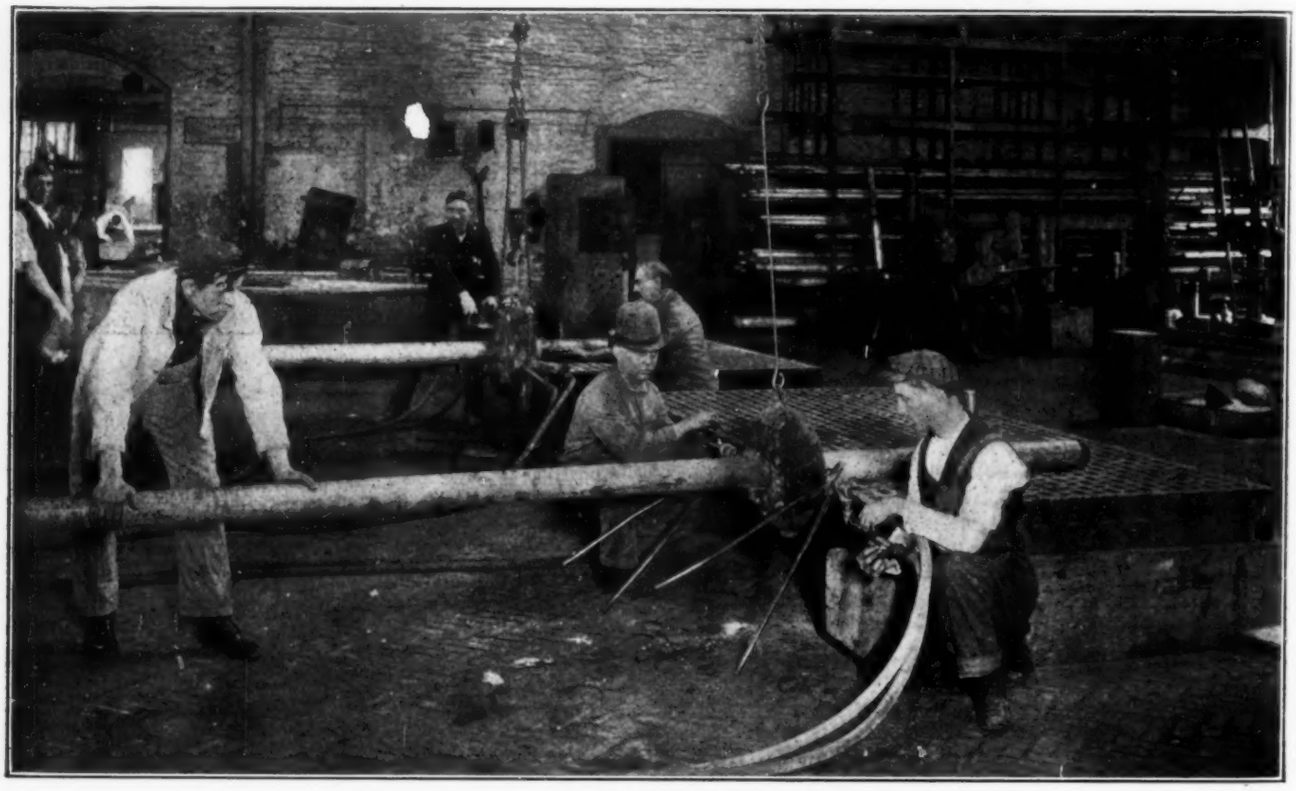


FIG. 3. PORTABLE PIPE-HEATING FURNACES

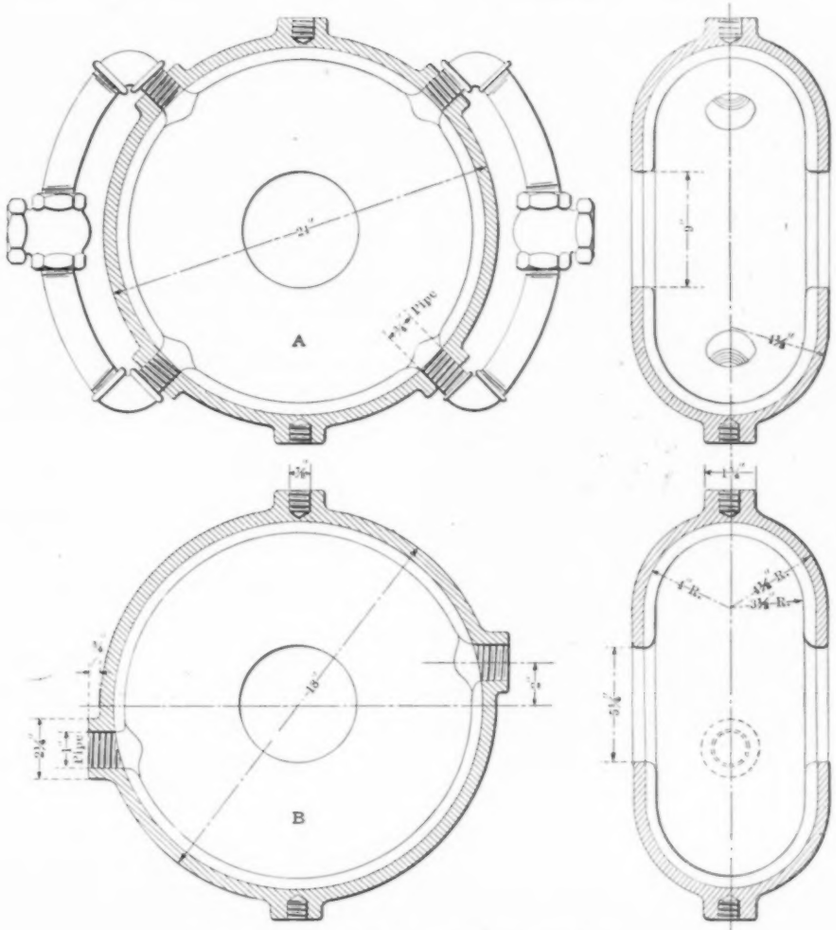


FIG. 4. DETAILS OF PIPE-HEATING FURNACES

gases. Similarly these dimensions would not need to be so great proportionally for a larger heater. Thus while *A*, Fig. 4, will heat a larger pipe than *B*, its combustion chamber has but little greater cross-sectional area than the latter. The size of hole for the pipe in the case of *A* is 9 inches; this allows an 8-inch pipe and smaller to be heated. The maximum pipe size in the case of *B* is 4½ inches.

At the left-hand rear corner of the floor, in Fig. 3, will be seen a large, circular hearth which is about 14 feet in diameter. A small section of the plan of this hearth is shown in Fig. 5. The method of heating is the same as in the case of the pipe heaters just described; namely, by gasolene in conjunction with compressed air. It could be used in conjunction with coal, coke or charcoal with suitable adaptations. The burner is in a small furnace below the level of the hearth and the flame shoots up through a narrow slot lined with firebrick or fireclay. The size of the slot is approximately 2x8 inches. Rods, or angle irons, or pipe can be laid across the flame in such a way as to give an exposure to the latter varying in length according to the angle made with the slot. The top of the hearth, which can be made of brick or concrete, can be kept perfectly clean. Its size allows long pieces to be handled with neatness and despatch. There is provision for five smiths or pipefitters to work at one time.

A Valve-testing Table

A fitting companion to the pipe-working

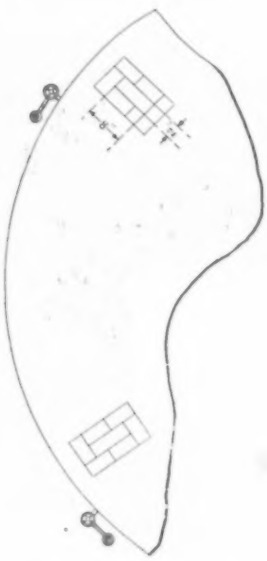


FIG. 5. ARRANGEMENT OF SLOTS IN PIPE-HEATING HEARTH

tools already shown is illustrated in Fig. 6; a testing table for valves arranged with a view to handling large numbers quickly. As seen, it is a cheap simple, yet effective, device calculated to be a valu-

FIG. 6. A VALVE-TESTING TABLE

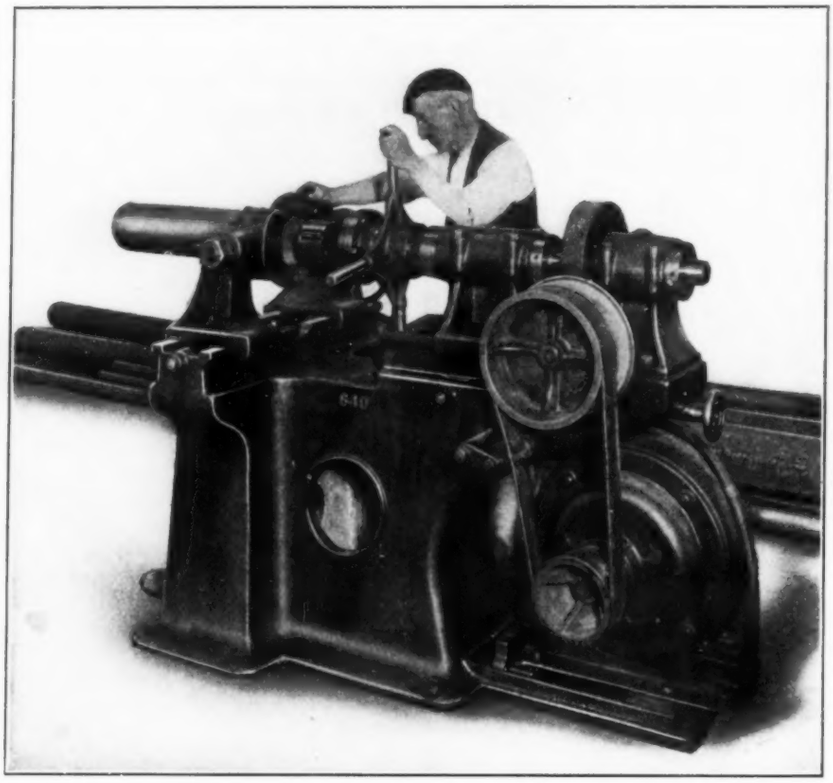


FIG. 7. MACHINE FOR MAKING-UP PIPE FLANGES

able adjunct to any shop where quantities of valves, traps, separators and pipe fittings for steam or water pressure are used or produced. The table shown is approximately 5 feet wide and 7 feet long. It has a channel around its edge to drain off drips; it is about 3 inches deep by 3 inches wide. The surface of the table is machined and slotted for ¾-inch holding-down bolts. There are eight holes drilled into the surface of the table in two rows of four each. They are conveniently spaced. The rows are about 2 feet apart, and the holes in each row are separated by about 18 or 20 inches. The holes are tapped and fitted with ½-inch gas plugs; one pipe system, under the table, serving all the holes. A hand-force pump is located conveniently in the system, and is fed from the town main. Where the latter furnishes water at a pressure of 75 or 100 pounds to the square inch, the assistance to the man at the pump handle is not to be ignored.

When starting a test the plugs are removed from as many holes as necessary, gaskets are laid around the holes and the valves are bolted directly on top of these, with a cover for the last one if several are stacked one above another. A suitable opening is left for the air to escape at the top, and the valve is opened enough to fill the bodies with water. After closing up and making everything tight one stroke of the pump puts the necessary pressure on every valve. With small valves having screw joints, a pipe is screwed into one of the holes as shown in front of the force pump in Fig. 6. With a stock of suitable nipples and sleeves, a string of small globe or gate valves can be put together and tested. Four pieces of 3½-inch galvanized pipe, flanged top and bottom, make suitable and substantial legs.

A Machine for Making-up Flanges

Fig. 7 shows a machine used for setting flanges on pipe. It is so simple that its principles will be readily grasped. The expanding head seen just about to enter the pipe has four rollers set parallel, and four on an incline, so that, while the parallel rolls are forcing the pipe outward to fill the thread in the flange, the inclined rolls catch the edge of the pipe and bead over the corner. The parallel rolls are turned slightly tapering and move outward against the pipe in regular tube-expander fashion; they are forced against the work by a taper mandrel set reversed.

Special T-slct Milling Machine of the R. K. LeBlond Machine Tool Company

Milling the T-slots in milling-machine tables if done on a standard knee-type milling machine, is a cumbersome and tedious job, especially when milling the larger size tables, which, on the Le Blond machines, are 74 inches long, and weigh about 1200 pounds.

The limited movement of the machine necessitates resetting of the work to mill the full length of the slots, and the great leverage, due to the overhang of the work when at either end of the cut throws excess strains on the table and saddle bearings, which soon destroy the accuracy of the milling machine.

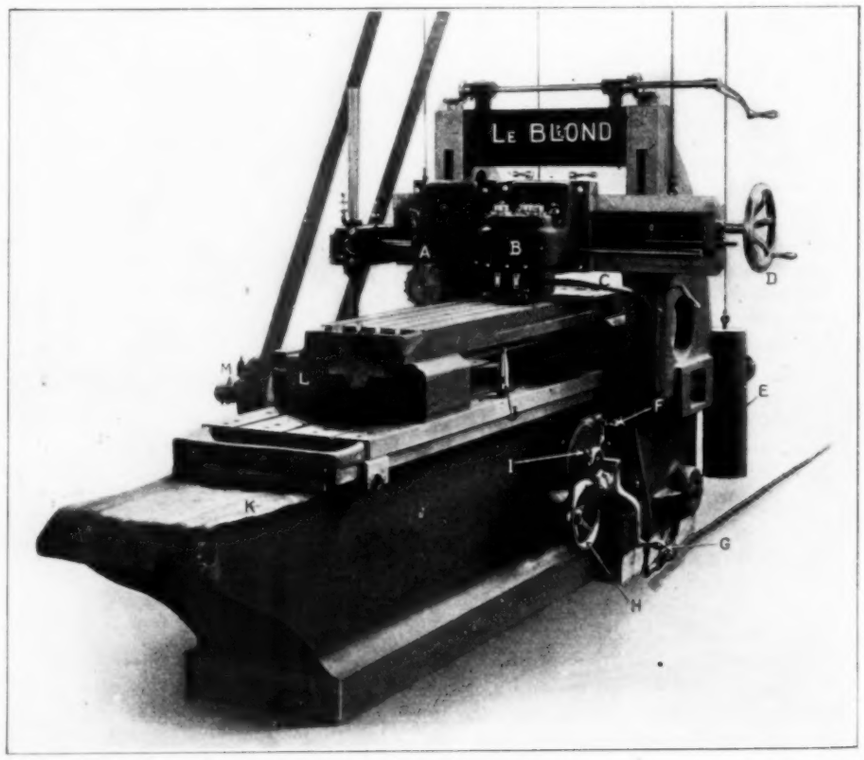


FIG. 1. SPECIAL T-SLOT MILLING MACHINE

After noting these difficulties and giving the subject due consideration, and not being able to find a machine on the market suited to our purpose, the R. K. Le Blond Machine Tool Company designed and built the machine described below. This machine, as seen from the illustration in Fig. 1, is of the planer type, which overcomes the difficulties in milling due to overhang. It is arranged for milling the three T-slots simultaneously, milling the trip-dog slot and milling off the end of the table.

Referring to Fig. 1, *A* is the end milling cutter; *B*, the triple milling head; *C*, the air supply to each cutter; *D*, the feed to end milling head; *E*, counterweight; *F*, the trip-feed lever; *G*, quick table returns; *H*, fine hand feed for table; *I*, the clutch-locking wheel; *J*, the cutter for side slot; *K*, the canvas cover to protect ways; *L*, the adjustable vise jaw to hold work, and *M*, the driving cone.

The cross-rail has two saddles; one of these carries cutter head permanently located. This head is used for milling the end of the table, and is shown in detail by Fig. 2.

The other saddle carries the head with three vertical spindles for milling the T-slots, and is shown in detail by Fig. 3. This head is removable, so that other heads can be substituted, with spindles spaced to correspond with the distance between the slots in the various size tables.

The trip-dog slot, at the side of the table, is first squared out with a cutter and extension inserted in one of the spindles of the T-slotting head. This cutter is seen in Fig. 1 resting on the table of the machine.

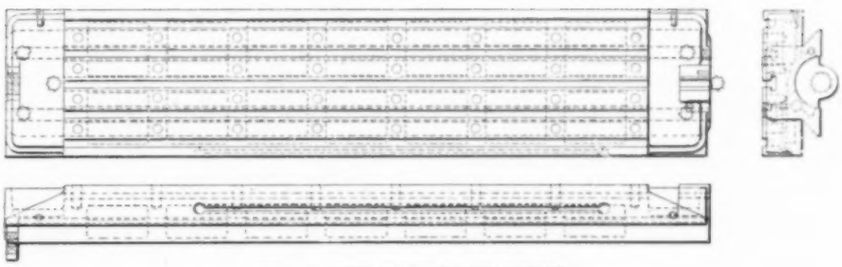


FIG. 4. THE WORK TO BE MILLED

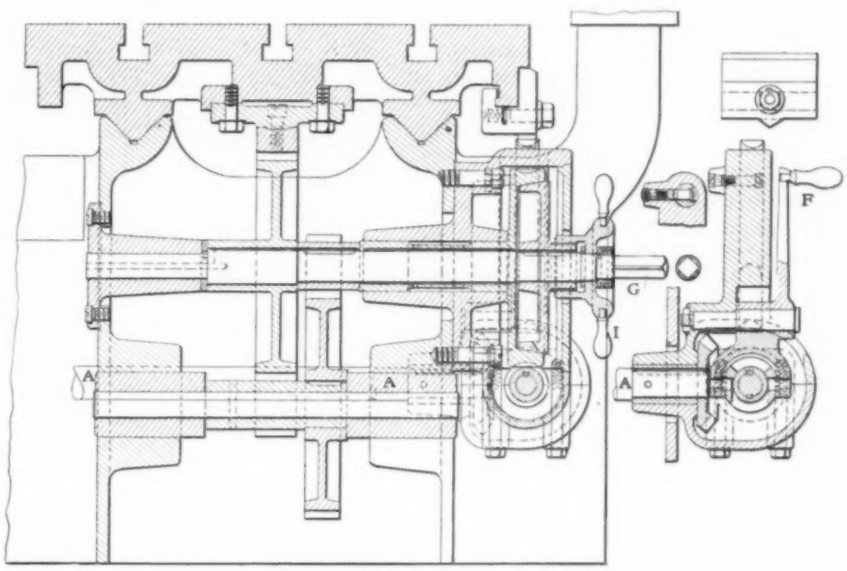


FIG. 5. THE METHOD OF DRIVING THE TABLE

The T-slot is undercut by resetting the table to bring the slot within range of one of the vertical spindles. Fig. 4 shows the design of milling-machine tables used in this case. These have a lug cast in the end for the dividing head. To mill the T-slot in this lug necessitates the middle spindle to be located to the rear of the

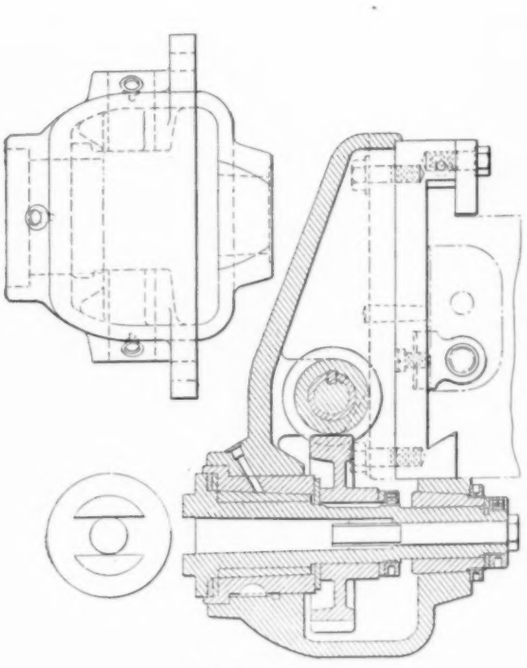


FIG. 2

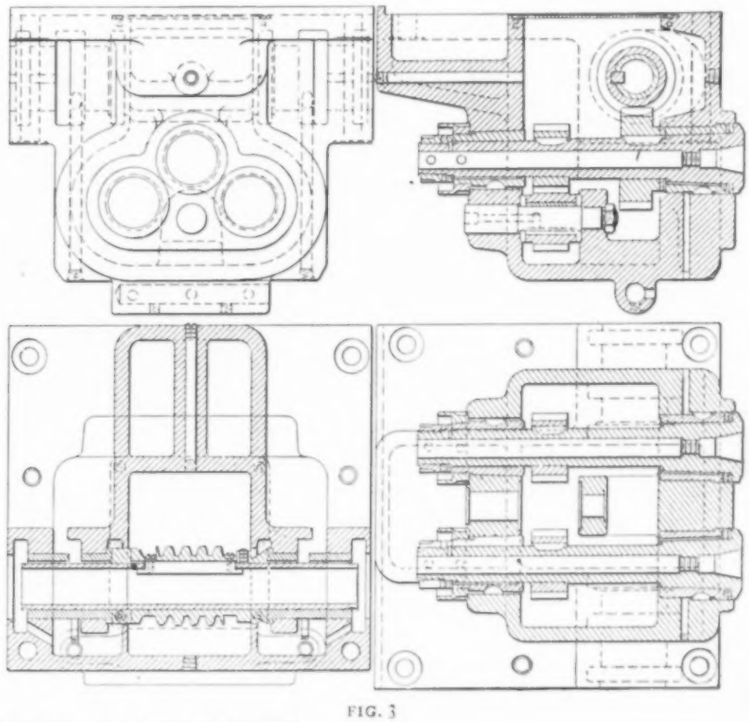


FIG. 3

DETAILS OF THE SPINDLES AND THEIR DRIVES

two outside spindles. The milling cutters on the blueprint show the position of the cutters at the beginning, also the position when the slot is finished, to show the necessity of spacing the spindles in this way.

The machine is driven from a two-speed countershaft, which runs at 500 and 225 revolutions per minute. The slow speed gives the proper surface speed to the cutter for milling the end of the table. The fast speed, in connection with the three-section cone pulley on the machine, gives three speeds of 170, 210 and 260 to the T-slotting spindles, to correspond to a surface speed of 53, 65 and 81 feet at the periphery of the cutter.

The feed to the work table is driven from the cone-pulley shaft through their standard quick-change gear feed boxes which is located near the cone pulley on the far side of the machine, and is not seen in Fig. 1, to the shaft *A*, thence through the reversing bevel gears between which the feed-tripping clutch is located, then on to the worm and worm wheel, and the compound gears to the table, as in Fig. 5.

The driving details are shown with *X* as the clutch, *I* the clutch handle, *G* the quick return, and *F* the feed-trip lever.

The table has feeds ranging from 1 to 12 inches per minute in either direction. The average rate of feed used for milling T-slots is 7 inches per minute. The machine is piped for air, an independent pipe leading to each cutter. This, of course, is an absolute necessity, for this class of milling, the speed depending largely upon keeping the cutters cool and free from chips.

Boring a Connecting-rod End Brass in a Jig

By Henry Munro

The illustrations herewith show a method devised to produce an ordinary connecting-rod end brass in three operations, viz., disk grinding, milling and drilling; instead of surface milling, end milling, drilling, assembling, boring, turning and milling, thus saving the setting-up time and the delay of at least two operations, and doing the job on a cheaper rated machine.

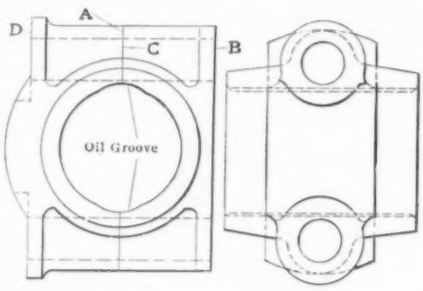


FIG. 1. CONNECTING-ROD END BRASS

A line drawing of the brass is shown in Fig. 1. The first operation is disk grinding. The faces *A* and *B*, Figs. 1 and 2, are ground to the right dimension from the rough faces *C* and *D* of each half respectively, then the face *C* of the bottom half is ground parallel to face *A* on a special grinding attachment. An occasional gaging and adjusting of the stop is all that is necessary to keep within very close limits of error.

The second operation consists in milling the clearance for the nuts on face *C*. This is done on a vertical milling machine with an end mill, to stops on the machine table to which face *B* is clamped. The third operation finishes the job. The jig, Fig. 2, is a gray-iron casting, of box section, strongly ribbed. The face *E* is machined to a certain dimension from the center line so that the joint of the brasses may coincide with the center line of the hole. The V-blocks *F* and *G* hold the work by the barrel section round the bolts. Block *F* or the swivel V-block, it will be noticed, has a pin let into the clamping screw *H* secured by a small pin and groove which allows the clamping screw to be tightened up without rotating the V-block. Block *G*, or the rocking V-block, has a strip on the back at right angles to the center line of the V, which is an easy fit in a groove in the main casting, as shown at *I*. The fillister-head screw is merely to keep the block from falling out when the piece is removed, and is quite clear of everything, allowing the block to rock sufficiently to accommodate itself to any variation there may be in the castings. The castings (shown by dot and dash lines) match up evenly in block *F* which has no rocking motion, the discrepancy, if any (one casting being longer than the other) being taken up by the rocking block *G*. The pins *J K* keep this block from moving endways along the slot *I*. If the pressure of the clamping screw *H* was brought to bear on the joint of the two half bushes the tendency would be to close them in at the joint, and in doing

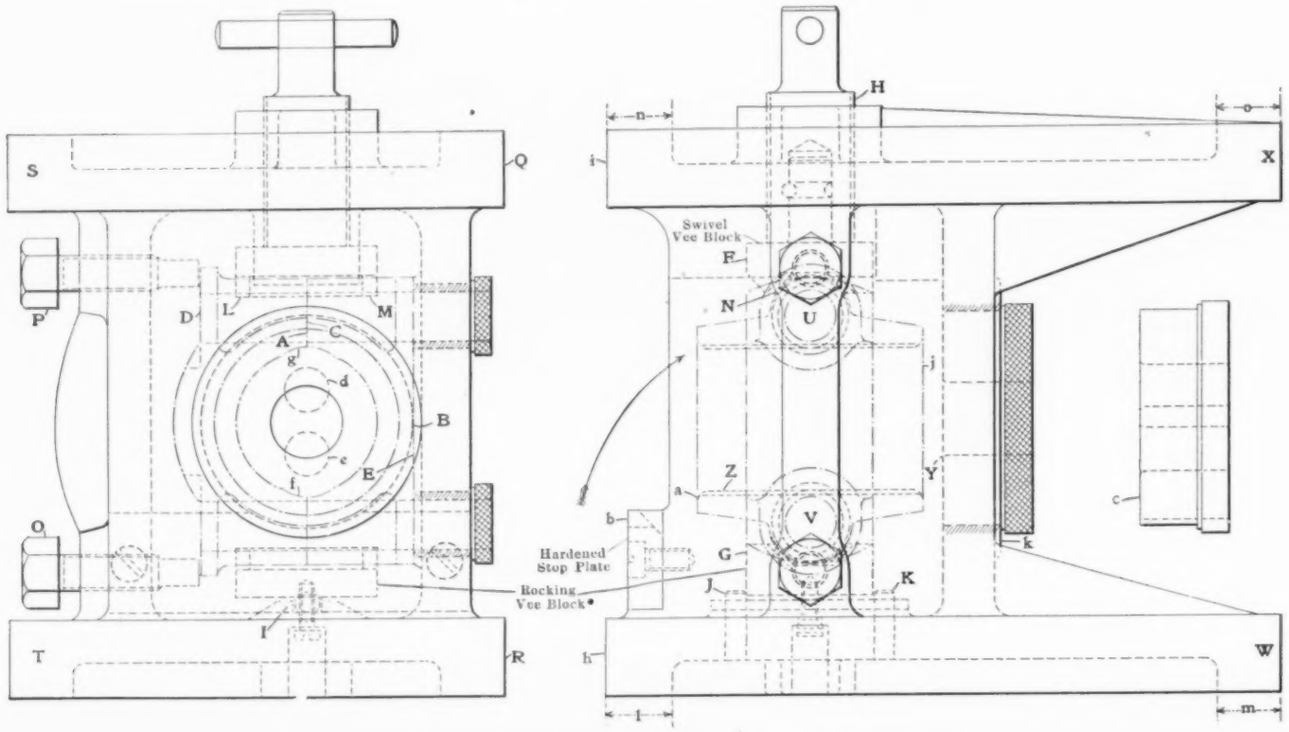


FIG. 2. JIG USED FOR BORING CONNECTING-ROD END BRASSES

so would set the bolt holes already drilled, out of alinement and when taken out of the jig again the work would spring back to its original shape, causing the bearing to be oval; again, if the piece took a permanent set the bolt holes would be out of line, as mentioned above. To prevent this the V-blocks are recessed in the center of their length, only ¼ inch being left at the ends, as shown at *L*, *M* and *N*, thus the castings are gripped where the metal is practically solid and the chances of bending are at a minimum. Further, the clamping screw is provided with no accommodation for the use of a spanner, and can only be turned by hand. The two half bushes are held down to the base of the jig by the two hexagon-head screws *O* and *P* as shown.

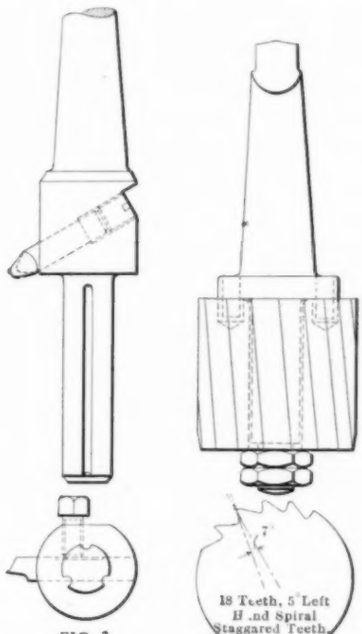


FIG. 3

FIG. 4

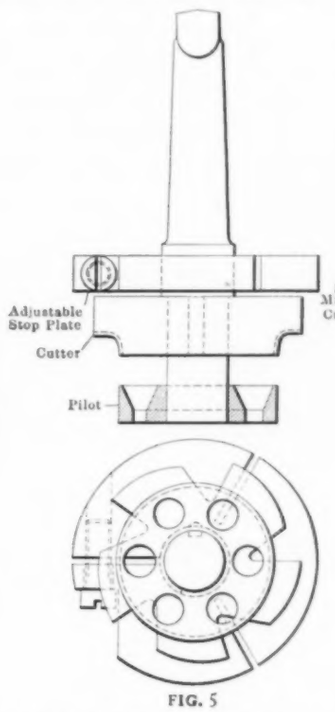


FIG. 5

FIG. 6

TOOLS FOR MACHINING CONNECTING-ROD END BRASSES

To mount the castings in the jig, the jig is placed on the machine table, resting on feet *Q* and *R*, the bottom half of the work is slipped into V-block *G* and swung round in the direction of the arrow, resting on face *E;* then the top half is inserted in a similar manner; clamping screw *H* is screwed up until it just contacts with the castings, and locates them in position, then screws *O* and *P* are tightened up, bringing the joints hard together; screw *H* is then tightened and the job is ready for the cut.

The jig is then clamped to the machine table by feet *S* and *T*, and holes *U* and *V* drilled and reamed. It is then clamped to the table on feet *W* and *X*, and with a special single-point boring tool, Fig. 3, the pilot of which is guided by bush *Y*, hole *Z* is bored. The hole is reamed with a reamer of the floating type shown in Fig. 4. Next is faced and formed the round edge at *a* with the facing tool Fig. 5, the pilot of which takes its bearing in the reamed hole; this tool is operated to a stop for depth. This stop plate or flange on the facing cutter, Fig. 5, is adjusted for the wear on the cutter by grinding, and is brought down onto the hardened stop plate *b* on the jig, preferably by hand lever feed. This positive stop or gage for depth does away with all gaging and measuring.

Next, bush *Y* is removed and bush *c* inserted. The latter has two holes 1 inch apart, as shown in dotted lines at *d* and *e*, Fig. 2. The bush is located by a screw, not shown, so that the center line of the pilot holes are in line with the work joint. The end cutter Fig. 6 is now mounted in the machine spindle with the pilot guided by hole *e*, Fig. 2, and groove *f* milled out. In a similar manner groove *g* is formed. The jig is then bolted to the machine table on feet *h* and *i*, the facing tool placed in the machine spindle and end *j* faced and formed until the stop on the tool strikes face *k*, thus giving the right depth. It will be noticed that the stop plates *b* and *k* on the jig are equidistant from the center line of the bolt holes, the same cutter being used for both sides, therefore the faces *a* and *j* on the work will be equally distant from the center line of the bolt holes, which fulfills the conditions required.

There is another simple point in the design of this jig which is worthy of notice; the hight, or thickness of the feet of the jig from the machine table is the same (1⅛ inches) in every case, as shown at *l*, *m*, *n* and *o*. In fact, all the drill jigs about this size, or that are to be used on this size of drilling machine, are made with feet of this size, so that a set of two or four clamping dogs form a full equipment for a machine, and are always set just right for the job. This does away with a miscellaneous collection of bolts and straps, which usually have to be dug from the bottom of a box of scrap.

The photograph Fig. 7 shows the first jig of this type I designed, and although it was for a smaller job it proved to be too light for the work and had to be braced as shown. The tools are clearly shown.

The forming and facing tool is of the inserted-blade type; the adjustable stop collar will also be noticed in the illustration.

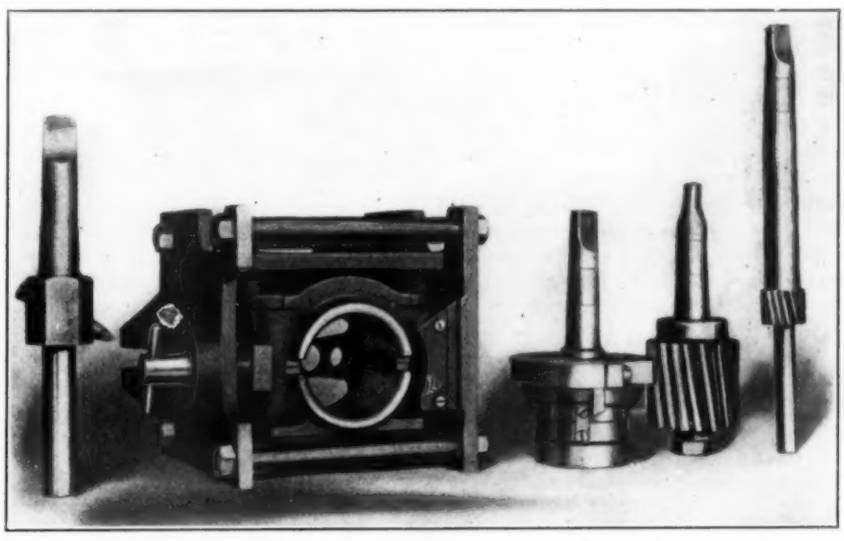


FIG. 7. JIG AND TOOLS FOR CONNECTING-ROD END BRASSES

A record in excavation work was made at Panama during the month of September in which period 3,158,886 cubic yards were removed. This represents more than double the amount excavated for the same month last year.

Details of Manufacturing Equipment

Foundry, Machine Shop, Testing, Storage and General Details That Bring About Effective Methods of Making and Importing Meters

SPECIAL CORRESPONDENCE

A preceding article illustrated and described interesting and effective special machine tools used at the plant of the Hersey Manufacturing Company, in South Boston, Mass., in the production of various types of water meters. This article will take up certain interesting and noteworthy details of manufacturing equipment, including foundry appliances, jigs and gages, a grinding fixture for inserted-toothed milling cutters, a gang drilling operation, the calibrating, inspecting and testing of meters, a durable and substantial work-bench and store-room equipment. These details are typical of the design and installation of the equipment of the entire plant and show the care with which they have been worked out in order to produce an efficient system of production.

Molding Benches and Patterns

The topmost floor of the newest building of this plant, built some two years ago, is devoted to the brass foundry. The bulk of the work is produced from molding-machine molds, although there is a certain amount of hand molding. A simple and useful hand-molders' bench is shown at the right in our half-tone illustration, Fig. 1. It consists of two plain cast-iron legs, tied together at the back, provided with a vibrator operated by a knee lever and having an air hose. It is, therefore, a vibrator molder's bench and brings to the hand molder the advantages of mechanical vibrating over hand rapping. At the right in this same illustration is seen a metal stand of the same substantial and durable construction as the bench, which has this same mechanical vibrator feature as well as a hand lift attachment. This type of molder's bench is used entirely in this foundry for the hand molding work.

A Berkshire machine is one of the molding machines in this foundry, and some of its pattern plates will be referred to later. This machine is, of course, particularly adapted for producing molds in large numbers from a given pattern. It often happens that a small number of castings are required, for some particular purpose, from a pattern or pattern plate that has been adapted to the Berkshire machine. Under such circumstances it is not economical to set up the machine for a small number of molds. To meet this condition the hand molding machine illustrated by Fig. 2 was developed. The top of this machine was made from a table from the Berkshire. It takes the regular Berkshire plates, is arranged with a vibrator and lifts the flask in the same way as does the Berkshire machine. As shown, the pins for making the sprue holes are in position; at the right is the handle for lifting the flask; at the left is a knee lever for operating the vibrator; and lying across the top is the usual air hose connection for cleaning. This mold-

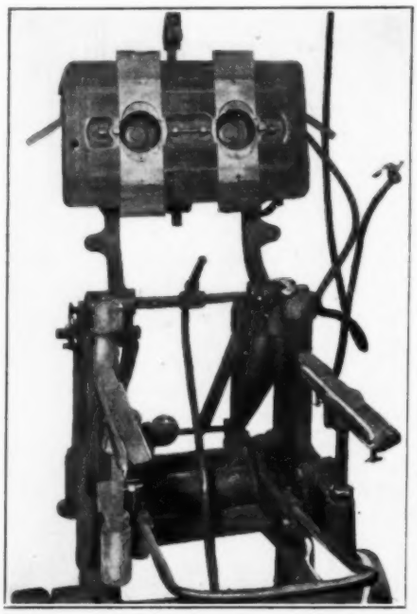


FIG. 3 A ROLL-OVER MOLDING MACHINE

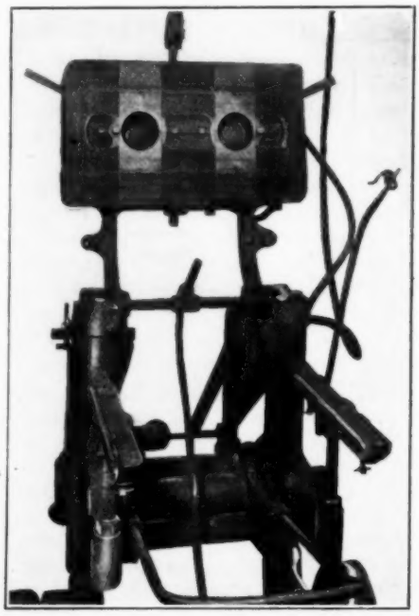


FIG. 4

FIG. 1 HAND MOLDER'S BENCHES WITH VIBRATOR ATTACHMENT

FIG. 2

ing machine was designed and made at the plant; the table shown in Fig. 1 originated in the foundry of a large western manufacturer.

Figs. 3 and 4 show a roll-over machine with the pattern plate for a small disk-meter casing. The feature of the casting is a ring that is molded by the sliding plates, shown open in Fig. 3 and closed in Fig. 4. These sliding plates are operated by the short, straight hand levers shown turned down in Fig. 3 and up in Fig. 4.

A group of pattern plates for the Berkshire machine is shown by Fig. 5. The two plates at the left-hand and the one at the extreme right are arranged for stooling. The stools in each case are shown plainly. In front of each plate is a representative casting. As this molding machine is not generally used for brass work, it is proper to call attention to the excellent results that are being obtained in its use at this foundry. While the number of molds per day is not as great as many of the records established in iron foundry work, still the machine has demonstrated itself to be perfectly practical for brass founding, and for the production of castings that can rightly be called complicated.

Gages and Jigs

The gage and drilling jigs, illustrated in the half-tone, Fig. 6, are illustrated with the purpose of showing the refinement with which small tools have been worked out. The ball and gage are used to gage the relative hight of the horizontal surface of the turned shoulder, and the spherical recess into which the ball fits. This system of gaging is common to this particular part throughout the entire range of disk meters. The gage block rests on the horizontal surface on four points, each pair of which are at opposite ends of a diameter. When in this position the gage point at the center must be tangent to the highest point of the ball.

A common nuisance in jig drilling is the mutilation of the body of the jig around jig bushings by the drill point. This objectionable feature is overcome, in the two drilling jigs shown, by placing a hard fiber washer around the bushing. A careless attempt to make the drill enter the hole in the bushing will thus bring the drill point in contact with the fiber washer, instead of the jig body, and thus neither jig body nor drill point will be injured. In case the washers become mutilated through long continued use it is an easy matter to replace them.

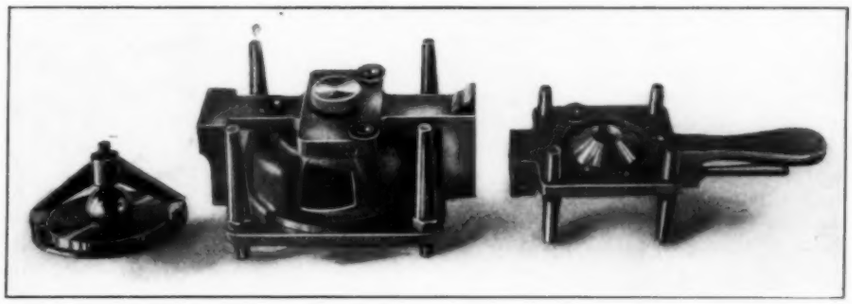


FIG. 6. GAGES AND DRILLING JIGS

A Grinding Fixture for Large Mills

It is an accepted fact that large face milling cutters are best ground in the position in which they are to be used, if it is possible to do so. In Fig. 7 is shown a 14-inch inserted-toothed milling cutter, such as are used for facing the ends of cast-iron flanges for water meters and their connections. The cutter is mounted on one spindle of a double-head, Brainard, horizontal milling machine. The grinding fixture is mounted on a taper arbor that fits the taper in the machine spindle. This arbor is threaded at its outer end, and running on this thread is a nut having an external thread that carries the body of the fixture. Adjustment of the fixture in and out, with reference to the face of the cutter teeth, is obtained by this nut, and it also serves to lock the body of the fixture in position after it is properly set. Swiveled to this fixture body is a slide whose motion traverses the wheel past the face of the cutter in grinding. A vertical slot is milled in a vertical projection from this slide, and clamped in this slot is the bearing for the emery-wheel spindle. This bearing, in addition to having a vertical adjustment in this slot, swivels about its shaft that passes through the slot. By a combination of these two movements the wheel can be set at any hight and to any vertical angle that is desired. An indexing finger, that cannot be seen in the illustration, is provided on the back of the fixture. This finger is arranged to bear against a tooth, two or three in number removed from the one that is being ground, and serves to accurately index the grinding.

The adjustments of the fixture are such that all of the faces of the cutter's teeth can be accurately ground to the required clearance angle. The emery-wheel spindle

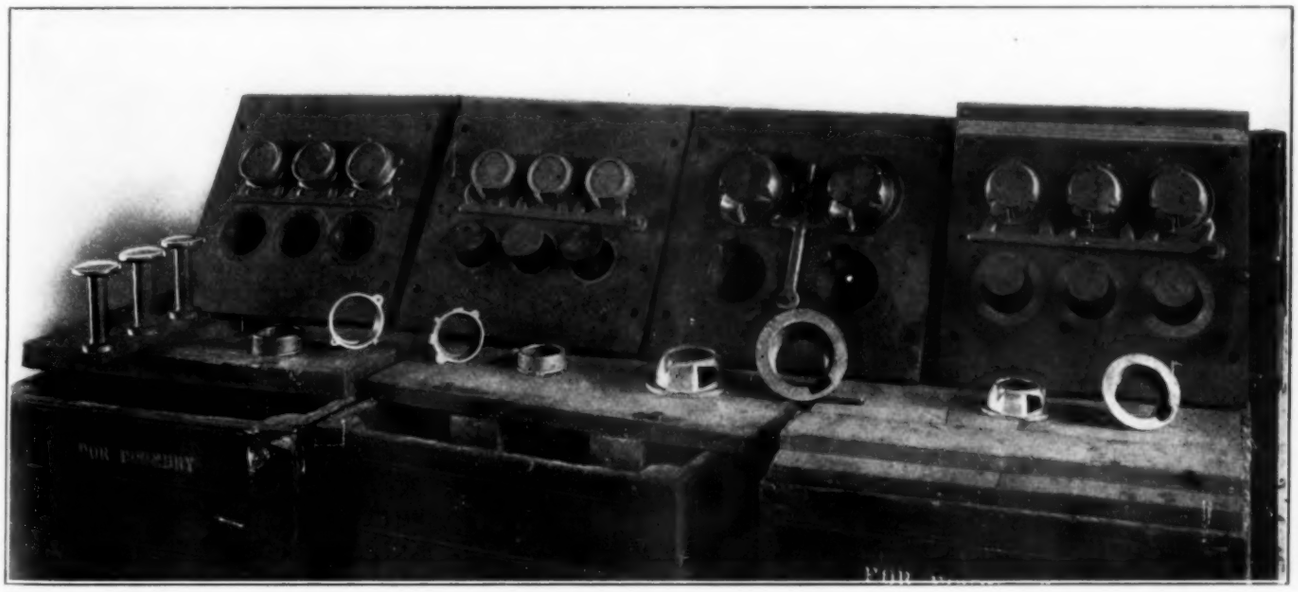


FIG. 5. PATTERN PLATE FOR THE BERKSHIRE MACHINE

is driven by a small electric motor through a flexible shaft.

A Drilling Operation

A successful substitution of upright drills for lathes is shown to the machining operation illustrated by Fig. 8. The part that is being machined is a meter casing, a composition casting. On each side of the casing is a connection, for the inlet and outlet, respectively. Beginning at the left with the operator, the first operation is drilling out the cored holes. A pin in the drill table serves to locate the lower connection, while the other is being machined. The second drill spindle carries a hollow mill that sizes the outside of the connection. The third spindle has an Errington self-opening die holder and a die and cuts the threads. The fourth and last spindle carries a chamfering and facing tool, for chamfering the outside corner and finishing the ends to gage dimension. The casting shown near the front of the table of the right-hand drill has the snap gage for this dimension in position. This gang of drill presses can be operated by one, two, three or four men as the demand requires.

The Testing Department

One of the most interesting departments of the entire plant is that which is devoted to the calibrating, inspecting and testing of finished meters. A number of long testing tables are provided for the smaller sizes. Each table is equipped with weighing or measuring tanks, as the case may be. In addition, there are floors arranged for handling the larger sizes of meters. Fig. 9 shows a 10-inch detector meter arranged for testing.

Before describing the testing apparatus, it is well worth while to briefly mention the features of this meter. It is a new type that has only been on the market for a comparatively short time. It was developed to use on fire-service lines; that is, lines put in primarily for fire protection. It is a notorious fact that much water is taken from such fire-service lines without being paid for. The underwriters would not permit of an ordinary meter for this service, because of the danger of clogging and stopping or checking the flow of water in case of a sudden draft in a fire emergency. To meet this condition the detector meter was developed. It accurately meters small quantities of water that are taken from the fire lines, up to a limit determined by a 6-per cent. drop in pressure from the pressure upon the meter. Directly in the main fire line is installed a detector, which is an especially constructed check valve. This valve has a differential seat closed by a clapper and keeps the fire line closed, until the draft is more than can properly be handled by the regular meter that is piped into the bypass. For ordinary amounts of water this meter in the bypass furnishes an accurate record. If, however, the draft is increased, so that the minimum drop of pressure of 6 per cept. is exceeded, the clapper valve lifts from its seat and the full area of the waterway of the fire main is opened through the detector. As soon as the clapper valve lifts from its seat a small amount of water flows from this seat, through a small indicating meter, shown in Fig. 9, between the large meter and the detector valve. This small meter is calibrated to a certain flow of water in a unit of time, and by its reading gives an indication of the length of time that the clapper valve has been raised.

FIG. 8. A SERIES OF OPERATIONS ON UPRIGHT DRILLS

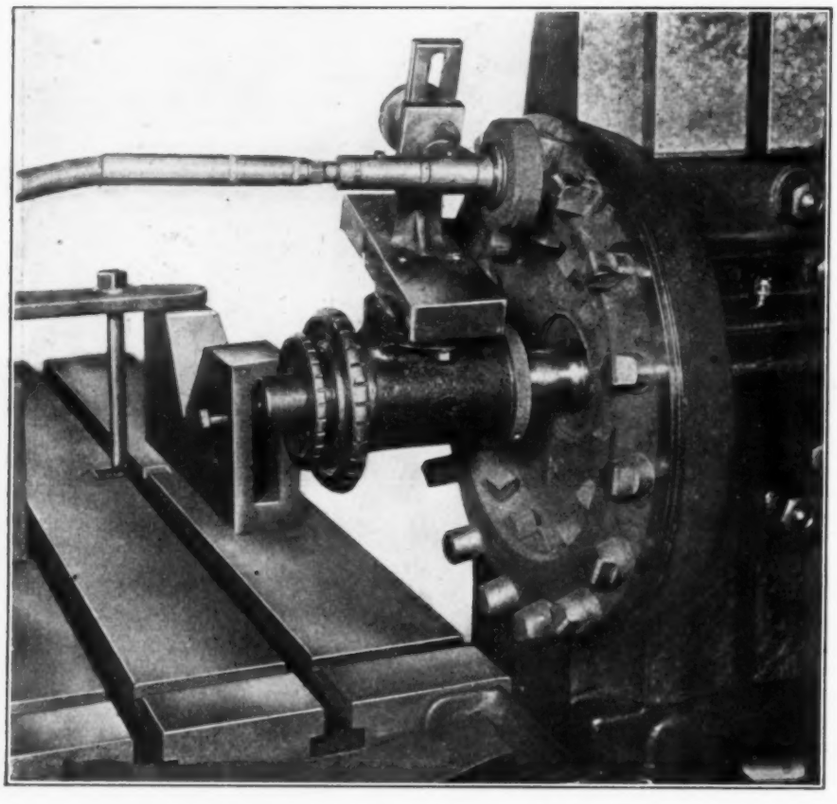


FIG. 7. A FACE MILL GRINDING FIXTURE

Returning to the testing apparatus; on the wall behind the meter in Fig. 9 is a mercury column graduated to tenths of pounds and having a total range of some 50 pounds. This is used to determine the amount of drop in pressure in the meter under test. Fig. 10 shows the other end of this testing floor. There are three measuring tanks and connecting piping. The large tank has four scales and a telltale, so that it can be used to measure cubic feet, United States gallons, pounds, or liters. A common scale serves for both of the smaller tanks. The larger tank has an inlet directly connected to a flange near the bottom. The smaller tanks are filled by a vertical pipe having on its upper end a swinging nozzle. This nozzle can direct the flow of water into either tank as desired. In this vertical pipe is a regulating valve that can be set to any desired proportion of pipe area to determine the flow.

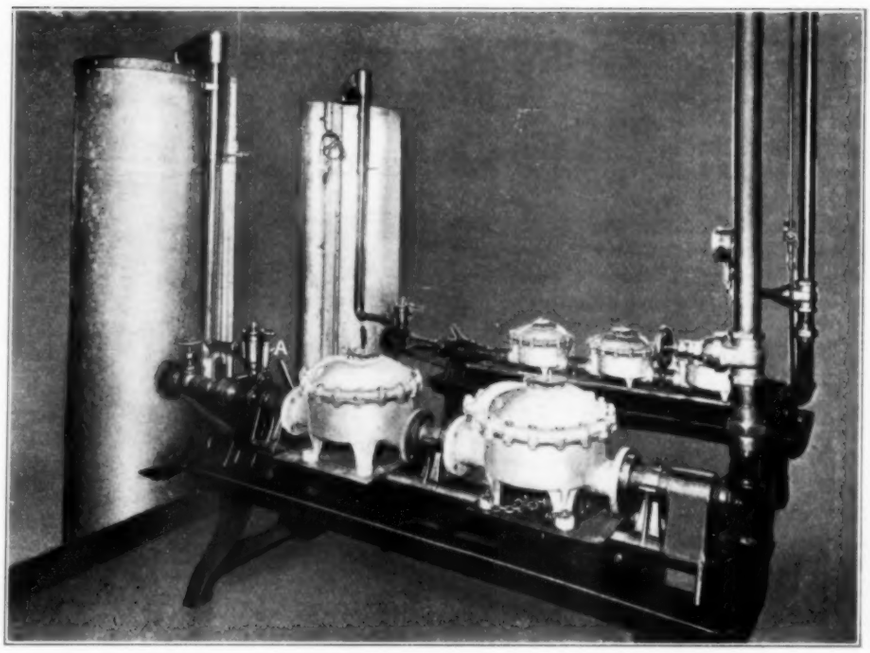


FIG. 11. TWO TESTING TABLES FOR SMALL METERS

Two testing tables for medium size meters are shown by Fig. 11. On the table in the foreground are set up two 3-inch disk meters; on the table in the rear are three 2-inch rotary meters. There are several interesting features in regard to these tables. Each table is provided with a parallel motion, so that the rails that carry the plates upon which the feet of the meters rest can be adjusted for hight, to bring the center lines of the meter flanges in line with the piping system. On the end of each table near the tank is provided a ratchet nut, the handle of which is indicated by the letter *A* in Fig. 11. Short interchangeable pieces of pipe are provided so that any size of meter can be placed upon a table. These pieces of pipe are inserted with suitable packings, and by means of the ratchet nut, the whole system can be clamped into position without the expenditure of time necessary to bolt and unbolt a number of flanges and filling-in pieces.

The meters shown in this illustration are provided with percentage dials, so that while under test the percentage that the meter over or under measures is read

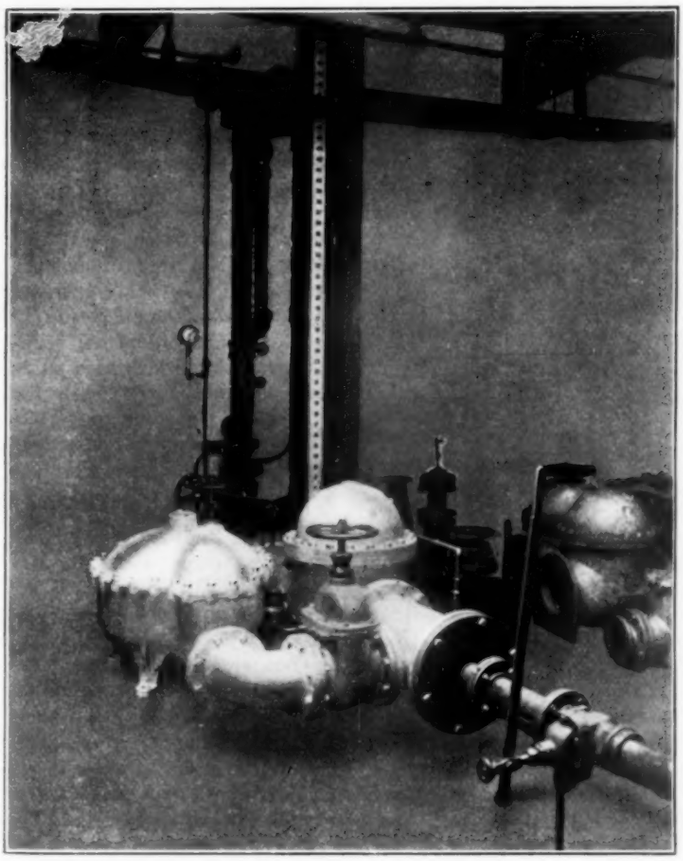


FIG. 9

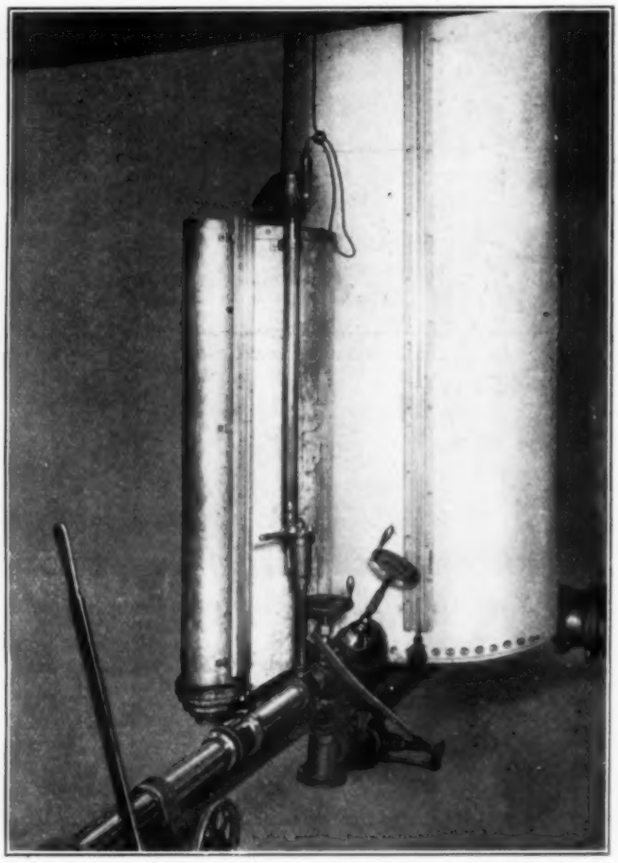


FIG. 10

THE TESTING FLOOR FOR LARGE METERS

directly. By this means it is easy to pick out the proper gear to use with the regular registering mechanism, in order that the meter shall register right. The tanks and connections for these tables are similar to those that have been described in connection with the large testing floor. For testing still smaller meters similar tables are used with quick operating connections; they are adapted to handle six meters on one table and so arranged that two tables can be tended by one man.

General Equipment

Shop benches are an element of interest to all machine-shop managers and superintendents. The one illustrated in Fig. 12 is somewhat out of the ordinary, and while undoubtedly expensive, still it has in a very large measure the essential element of durability. The legs are a substantial iron casting of an I-section. The front of the bench, for a width of about 15 inches, is made up of 3-inch maple, bowling-alley stock, tongued and grooved together, built up on edge into a structure that is as solid as a heavy plank and more rigid and wear-resisting because it presents edge grain to wear rather than surface grain. The back of the bench is a substantial plank of maple and the bench is provided with a suitable backboard. We fail to see how warping or shrinking can have much influence in distorting such a bench front.

store-room. The finished store-room itself is provided with these standard boxes wherever the parts warrant. In other cases a system of heavy shelving is used. Fig. 13 shows a section of the finished-

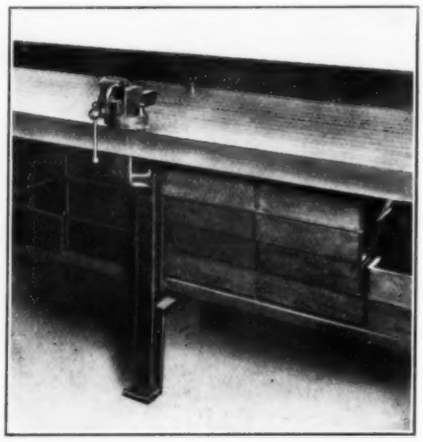


FIG. 12. A DURABLE SHOP BENCH

stock storage in the basement. It does justice to the storage of heavier parts, but hardly exemplifies the use of the unit-box system.

Calling System for the Executives

A problem in every large manufacturing plant is the establishing of immediate

FIG. 13. STORAGE RACKS OF THE HERSEY MANUFACTURING COMPANY

The question of storage is important in any manufacturing plant. Here, a unit box has been selected, and the general scheme of transporting material is, a given order of castings fill a definite number of unit-sized boxes, start in those boxes from the foundry or rough-casting storage room and continues in them until all of the manufacturing has been finished and the parts are ready for the finished

communication with members of the executive force, at any time and at any place where they may happen to be. A shop telephone system usually furnishes means of communication, but various schemes are used to attract the attention of the person wanted. Among these are a given number of blasts on the factory whistle, showing of symbols by means of electric lamps in every department, a code of signals by means of gongs, and the like. One of the simplest and most effective of such system is the one in use at this plant.

Throughout all departments of the plant, a Bell intercommunicating telephone system is arranged for connection with the trunk lines through an operator's desk in the main office. Installed in connection with this telephone system is a bell system, the buttons of which are located beside the telephone instruments and the bells are in a convenient location in each department. If a member of the executive force is wanted to answer a long-distance telephone call, or by any other member of the executive force, a code signal is rung from the nearest telephone station by the person who wishes to enter into communication with him or by the desk operator in the office. This code signal rings in every department in the plant. At the same time that the code signal is rung, the telephone at the station from whence the ringing is done is put into telephonic communication with all of the other stations of the plant by means of a plugging arrangement. Thus when the attention of the person who is wanted is arrested by the ringing of his code signal, he goes to the nearest telephone station and is in instant communication with the party who wishes to talk with him, whether that party is calling over an outside long-distance or trunk line, or from one of the factory stations. The operation of this system is extremely simple and effective, although it may seem a little complicated in description.

The tests of different coals under steam boilers, carried on under the supervision of the technologic branch of the U. S. Geological Survey have shown the possibility of increasing the general efficiency of hand-fired steam boilers from 10 to 15 per cent. over ordinary results. If this saving could be made in the great number of hand-fired boilers now being operated in the United States it would result in large saving in the fuel bill of the country. Experiments which have been made with residence heating boilers justify the belief that it will be possible to perfect such types of boilers as may economically give a smokeless operation for residence heating.

The Pennsylvania Railroad forestry department has just completed its forestry planting for this year. It is stated according to the *Scientific American* that 625,000 trees were planted. This makes a total of 2,425,000 trees set out by the Pennsylvania Railroad up to the present time. The object is to create an adequate supply of timber for ties required in years to come. The Pennsylvania Railroad evidently is taking active steps in regard to the preservation of natural resources. The true way of preserving our forests is not necessarily not to use them, but to replant them.

Table for Spacing Holes in Circles

A Highly Useful Table for All Who Have Occasion to Divide Circles into Any Number of Parts up to Five Hundred

BY F. W. SEIDENSTICKER

The following table is reprinted from our issue of Sept. 27, 1900, in response to a request which expresses so high an appreciation of its value to patternmakers and others that we cannot ignore it. The method of using the table will be found at the bottom of the page. When sending in the table originally Mr. Seidensticker said that "the table of sines given in Trautwine was used for calculating and the table is correct with possibly an error of 1 in the last decimal place."—ED.]

No Sides.	Angle.	Sine.
3	60-	0.8660254
4	45-	0.7071068
5	35-	0.5877853
6	30-	0.5000000
7	25-42-51.42	0.4338837
8	22-30	0.3826834
9	20-	0.3420201
10	18-	0.3090170
11	16-21-49.09	0.2817325
12	15-	0.2588190
13	13-50-46.15	0.2393157
14	12-51-25.71	0.2225208
15	12-	0.2079116
16	11-15	0.1950903
17	10-35-17.64	0.1837495
18	10-	0.1736481
19	9-28-25.26	0.1645945
20	9-	0.1564344
21	8-34-17.14	0.1490422
22	8-10-54.54	0.1423148
23	7-49-33.91	0.1361666
24	7-30	0.1305262
25	7-12	0.1253332
26	6-55-23.07	0.1205366
27	6-40	0.1160929
28	6-25-42.85	0.1119644
29	6-12-24.82	0.1081189
30	6-	0.1045284
31	5-48-23.22	0.1011683
32	5-37-30	0.0980171
33	5-27-16.36	0.0950560
34	5-17-38.82	0.0922683
35	5- 8-34.28	0.0896392
36	5-	0.0871557
37	4-51-53.51	0.0848058
38	4-44-12.63	0.0825793
39	4-36-55.38	0.0804665
40	4-30	0.0784591
41	4-23-24.87	0.0765492
42	4-17- 8.57	0.0747301
43	4-11- 9.76	0.0729952
44	4- 5-27.27	0.0713391
45	4-	0.0697565
46	3-54-46.95	0.0682423
47	3-49-47.23	0.0667926
48	3-45	0.0654031
49	3-40-24.49	0.0640702
50	3-36	0.0627905
51	3-31-45.88	0.0615609
52	3-27-41.53	0.0603784
53	3-23-46.41	0.0592405
54	3-20	0.0581448
55	3-16-21.81	0.0570887
56	3-12-51.42	0.0560704
57	3- 9-28.42	0.0550877
58	3- 6-12.41	0.0541388
59	3- 3- 3.05	0.0532221
60	3-	0.0523360
61	2-57- 2.95	0.0514787
62	2-54-11.61	0.0506491
63	2-51-25.71	0.0498458
64	2-48-45	0.0490676
65	2-46- 9.23	0.0483133
66	2-43-38.18	0.0475819
67	2-41-11.64	0.0468722
68	2-38-49.41	0.0461834
69	2-36-31.30	0.0455145
70	2-34-17.14	0.0448648
71	2-32- 6.76	0.0442333
72	2-30	0.0436194
73	2-27-56.71	0.0430222
74	2-25-56.75	0.0422411
75	2-24	0.0418757
76	2-22- 6.31	0.0413249
77	2-20-15.58	0.0407885
78	2-18-27.69	0.0402659
79	2-16-42.53	0.0397565
80	2-15	0.0392598
81	2-13-20	0.0387753
82	2-11-42.45	0.0383027
83	2-10- 7.22	0.0378414
84	2- 8-34.28	0.0373911
85	2- 7- 3.54	0.0369515
86	2- 5-34.88	0.0365220
87	2- 4- 8.27	0.0361023
88	2- 2-43.63	0.0356923
89	2- 1-20.89	0.0352914
90	2-	0.0348995
91	1-58-40.87	0.0345160
92	1-57-23.47	0.0341410
93	1-56- 7.74	0.0337741
94	1-54-53.61	0.0334149
95	1-53-41.05	0.0330633
96	1-52-30	0.0327190
97	1-51-20.41	0.0323818
98	1-50-12.24	0.0320515
99	1-49- 5.45	0.0317279
100	1-48	0.0314107
101	1-46-55.84	0.0310998
102	1-45-52.94	0.0307950
103	1-44-51.26	0.0304961
104	1-43-50.76	0.0302029
105	1-42-51.42	0.0299154
106	1-41-53.20	0.0296332
107	1-40-56.07	0.0293564
108	1-40-	0.0290847
109	1-39- 4.95	0.0288179
110	1-38-10.90	0.0285560
111	1-37-17.83	0.0282488
112	1-36-25.71	0.0280462
113	1-35-34.51	0.0277981
114	1-34-44.21	0.0275543
115	1-33-54.78	0.0273147
116	1-33- 6.20	0.0270793
117	1-32-18.46	0.0268479
118	1-31-31.52	0.0266204
119	1-30-45.38	0.0263968
120	1-30	0.0261769
121	1-29-15.37	0.0259606
122	1-28-31.47	0.0257478
123	1-27-48.29	0.0255386
124	1-27- 5.80	0.0253326
125	1-26-24	0.0251300
126	1-25-42.85	0.0249306
127	1-25- 2.36	0.0247344
128	1-24-22.50	0.0245412
129	1-23-43.25	0.0243509
130	1-23- 4.61	0.0241637
131	1-22-26.56	0.0239793
132	1-21-49.09	0.0237976
133	1-21-12.18	0.0236188
134	1-20-35.82	0.0234425
135	1-20	0.0232689
136	1-19-24.70	0.0230978
137	1-18-49.92	0.0229292
138	1-18-15.65	0.0227631
139	1-17-41.87	0.0225994
140	1-17- 8.57	0.0224380
141	1-16-35.74	0.0222789
142	1-16- 3.38	0.0221220
143	1-15-31.46	0.0219673
144	1-15	0.0218148
145	1-14-28.96	0.0216644
146	1-13-58.35	0.0215160
147	1-13-28.16	0.0213697
148	1-12-58.37	0.0212253
149	1-12-28.99	0.0210829
150	1-12	0.0209424
151	1-11-31.39	0.0208037
152	1-11- 3.15	0.0206668
153	1-10-35.29	0.0205318
154	1-10- 7.79	0.0203985
155	1- 9-40.64	0.0202669
156	1- 9-13.84	0.0201370
157	1- 8-47.38	0.0200087
158	1- 8-21.26	0.0198821
159	1- 7-55.47	0.0197571
160	1- 7-30	0.0196336
161	1- 7- 4.84	0.0195117
162	1- 6-40	0.0193913
163	1- 6-15.46	0.0192723
164	1- 5-51.21	0.0191548
165	1- 5-27.27	0.0190387
166	1- 5- 3.61	0.0189241
167	1- 4-40.23	0.0188107
168	1- 4-17.14	0.0186988
169	1- 3-54.31	0.0185881
170	1- 3-31.76	0.0184788
171	1- 3- 9.47	0.0183708
172	1- 2-47.44	0.0182640
173	1- 2-25.66	0.0181584
174	1- 2- 4.13	0.0180541
175	1- 1-42.85	0.0179509
176	1- 1-21.81	0.0178489
177	1- 1- 1.01	0.0177481
178	1- 0-40.44	0.0176484
179	1- 0-20.11	0.0175498
180	1-	0.0174524
181	59-40.11	0.0173559
182	59-20.43	0.0172605
183	59- 0.98	0.0171663
184	58-41.73	0.0170730
185	58-22.70	0.0169807
186	58- 3.87	0.0168894
187	57-45.24	0.0167991
188	57-26.30	0.0167097
189	57- 8.57	0.0166214
190	56-50.52	0.0165339
191	56-32.67	0.0164473
192	56-15	0.0163617
193	55-57.51	0.0162769
194	55-40.20	0.0161930
195	55-23.07	0.0161100
196	55- 6.12	0.0160278
197	54-49.34	0.0159464
198	54-32.72	0.0158659
199	54-16.28	0.0157862
200	54-	0.0157073
201	53-43.88	0.0156294
202	53-27.92	0.0155518
203	53-12.12	0.0154752
204	52-56.47	0.0153993
205	52-40.97	0.0153242
206	52-25.63	0.0152498
207	52-10.44	0.0151764
208	51-55.38	0.0151033
209	51-40.48	0.0150310
210	51-25.71	0.0149595
211	51-11.09	0.0148886
212	50-56.60	0.0148183
213	50-42.25	0.0147487
214	50-28.04	0.0146798
215	50-13.96	0.0146115
216	50-	0.0145439
217	49-46.17	0.0144769
218	49-32.48	0.0144104
219	49-18.91	0.0143446
220	49- 5.46	0.0142794
221	48-52.13	0.0142148
222	48-38.92	0.0141508
223	48-25.83	0.0140874
224	48-12.86	0.0140245
225	48-	0.0139622
226	47-47.26	0.0139004
227	47-34.63	0.0138392
228	47-22.11	0.0137785
229	47- 9.69	0.0137183
230	46-57.39	0.0136587
231	46-45.19	0.0135995
232	46-33.10	0.0135409
233	46-21.11	0.0134828
234	46- 9.23	0.0134252
235	45-57.45	0.0133681
236	45-45.76	0.0133115
237	45-34.18	0.0132553
238	45-22.69	0.0131996
239	45-11.29	0.0131444
240	45-	0.0130896
241	44-48.80	0.0130353
242	44-37.68	0.0129814
243	44-26.67	0.0129280
244	44-15.74	0.0128750
245	44- 4.90	0.0128225
246	43-54.15	0.0127704
247	43-43.48	0.0127187
248	43-32.90	0.0126674
249	43-22.41	0.0126165
250	43-12	0.0125661

Table of Sides and Angles of Polygons.

Explanatory: The table gives the number of sides (3 to 250 inclusive) of polygons, one-half of the angle subtended by a side and the sine of that half angle. To get the length of a side of any polygon, of a number of sides included in the limits of the table, multiply the corresponding sine in the table by the diameter of the circumscribed circle.

Sides.	Angle.	Sine.	Sides.	Angle.	Sine.	Sides.	Angle.	Sine.
251	43- 1.67	0.0125160	335	32-14.33	0.0093778	419	25-46.54	0.0074977
252	42-51.43	0.0124663	336	32- 8.57	0.0093499			
253	42-41.26	0.0124171	337	32- 2.85	0.0093221	420	25-42.86	0.0074799
254	42-31.18	0.0123682	338	31-57.16	0.0092945	421	25-39.19	0.0074621
255	42-21.18	0.0123197	339	31-51.50	0.0092671	422	25-35.54	0.0074444
256	42-11.25	0.0122715				423	25-31.91	0.0074268
257	42- 1.40	0.0122238	340	31-45.88	0.0092398	424	25-28.30	0.0074093
258	41-51.63	0.0121764	341	31-40.29	0.0092127	425	25-24.70	0.0073919
259	41-41.93	0.0121294	342	31-34.74	0.0091858	426	25-21.12	0.0073745
			343	31-29.21	0.0091590	427	25-17.56	0.0073573
260	41-32.31	0.0120827	344	31-23.72	0.0091324	428	25-14.02	0.0073401
261	41-22.76	0.0120364	345	31-18.26	0.0091059	429	25-10.49	0.0073230
262	41-13.28	0.0119905	346	31-12.83	0.0090796			
263	41- 3.88	0.0119449	347	31- 7.44	0.0090534	430	25- 6.98	0.0073059
264	40-54.54	0.0118997	348	31- 2.07	0.0090274	431	25- 3.48	0.0072890
265	40-45.28	0.0118548	349	30-56.73	0.0090016	432	25-	0.0072721
266	40-36.09	0.0118102				433	24-56.54	0.0072553
267	40-26.96	0.0117660	350	30-51.43	0.0089758	434	24-53.09	0.0072386
268	40-17.91	0.0117221	351	30-46.15	0.0089502	435	24-49.66	0.0072220
269	40- 8.93	0.0116786	352	30-40.91	0.0089248	436	24-46.24	0.0072054
			353	30-35.69	0.0088996	437	24-42.84	0.0071889
270	40-	0.0116353	354	30-30.51	0.0088744	438	24-39.45	0.0071725
271	39-51.14	0.0115923	355	30-25.35	0.0088494	439	24-36.08	0.0071562
272	39-42.35	0.0115497	356	30-20.22	0.0088245			
273	39-33.63	0.0115074	357	30-15.12	0.0087998	440	24-32.73	0.0071399
274	39-24.96	0.0114654	358	30-10.05	0.0087753	441	24-29.39	0.0071237
275	39-16.36	0.0114237	359	30- 5.01	0.0087508	442	24-26.06	0.0071076
276	39- 7.83	0.0113823				443	24-22.75	0.0070916
277	38-59.35	0.0113412	360	30-	0.0087265	444	24-19.46	0.0070756
278	38-50.94	0.0113004	361	29-55.01	0.0087023	445	24-16.18	0.0070597
279	38-42.58	0.0112599	362	29-50.05	0.0086783	446	24-12.91	0.0070439
			363	29-45.12	0.0086544	447	24- 9.66	0.0070281
280	38-34.28	0.0112197	364	29-40.22	0.0086306	448	24- 6.43	0.0070124
281	38-26.05	0.0111798	365	29-35.34	0.0086070	449	24- 3.21	0.0069968
282	38-17.87	0.0111401	366	29-30.49	0.0085835			
283	38- 9.75	0.0111008	367	29-25.67	0.0085601	450	24-	0.0069813
284	38- 1.69	0.0110617	368	29-20.87	0.0085368	451	23-56.81	0.0069658
285	37-53.68	0.0110229	369	29-16.10	0.0085137	452	23-53.63	0.0069504
286	37-45.73	0.0109844				453	23-50.46	0.0069351
287	37-37.84	0.0109461	370	29-11.35	0.0084907	454	23-47.31	0.0069198
288	37-30	0.0109081	371	29- 6.63	0.0084678	455	23-44.17	0.0069046
289	37-22.21	0.0108704	372	29- 1.94	0.0084451	456	23-41.05	0.0068894
			373	28-57.27	0.0084224	457	23-37.94	0.0068744
290	37-14.48	0.0108329	374	28-52.62	0.0083999	458	23-34.84	0.0068594
291	37- 6.80	0.0107957	375	28-48	0.0083775	459	23-31.76	0.0068444
292	36-59.18	0.0107587	376	28-43.40	0.0083552			
293	36-51.60	0.0107220	377	28-38.83	0.0083331	460	23-28.69	0.0068295
294	36-44.08	0.0106855	378	28-34.28	0.0083110	461	23-25.64	0.0068147
295	36-36.61	0.0106493	379	28-29.76	0.0082891	462	23-22.60	0.0067999
296	36-29.19	0.0106133				463	23-19.57	0.0067852
287	36-21.82	0.0105776	380	28-25.26	0.0082673	464	23-16.55	0.0067706
298	36-14.50	0.0105421	381	28-20.78	0.0082456	465	23-13.55	0.0067561
299	36- 7.22	0.0105068	382	28-16.33	0.0082240	466	23-10.56	0.0067416
			383	28-11.91	0.0082025	467	23- 7.58	0.0067272
300	36-	0.0104718	384	28- 7.50	0.0081812	468	23- 4.61	0.0067128
301	35-52.82	0.0104370	385	28- 3.12	0.0081599	469	23- 1.66	0.0066985
302	35-45.69	0.0104024	386	27-58.76	0.0081387			
303	35-38.61	0.0103681	387	27-54.42	0.0081177	470	22-58.72	0.0066842
304	35-31.58	0.0103340	388	27-50.10	0.0080968	471	22-55.79	0.0066700
305	35-24.59	0.0103001	389	27-45.81	0.0080760	472	22-52.88	0.0066559
306	35-17.65	0.0102665				473	22-49.98	0.0066418
307	35-10.75	0.0102330	390	27-41.54	0.0080553	474	22-47.09	0.0066278
308	35- 3.90	0.0101998	391	27-37.29	0.0080347	475	22-44.21	0.0066138
309	34-57.09	0.0101668	392	27-33.06	0.0080142	476	22-41.34	0.0065999
			393	27-28.85	0.0079938	477	22-38.49	0.0065861
310	34-50.32	0.0101340	394	27-24.67	0.0079735	478	22-35.65	0.0065723
311	34-43.60	0.0101014	395	27-20.51	0.0079533	479	22-32.82	0.0065585
312	34-36.92	0.0100690	396	27-16.36	0.0079332			
313	34-30.29	0.0100368	397	27-12.24	0.0079132	480	22-30	0.0065449
314	34-23.69	0.0100049	398	27- 8.14	0.0078934	481	22-27.20	0.0065313
315	34-17.14	0.0099731	399	27- 4.06	0.0078736	482	22-24.40	0.0065178
316	34-10.63	0.0099415				483	22-21.61	0.0065043
317	34- 4.16	0.0099102	400	27-	0.0078539	484	22-18.84	0.0064909
318	33-57.74	0.0098791	401	26-55.96	0.0078343	485	22-16.08	0.0064775
319	33-51.35	0.0098482	402	26-51.94	0.0078148	486	22-13.33	0.0064641
			403	26-47.94	0.0077954	487	22-10.59	0.0064509
320	33-45	0.0098174	404	26-43.96	0.0077761	488	22- 7.87	0.0064377
321	33-38.69	0.0097868	405	26-40	0.0077569	489	22- 5.16	0.0064245
322	33-32.42	0.0097564	406	26-36.06	0.0077378			
323	33-26.19	0.0097261	407	26-32.14	0.0077188	490	22- 2.45	0.0064114
324	33-20	0.0096961	408	26-28.23	0.0076999	491	21-59.75	0.0063983
325	33-13.85	0.0096663	409	26-24.35	0.0076811	492	21-57.07	0.0063853
326	33- 7.73	0.0096367				493	21-54.40	0.0063723
327	33- 1.65	0.0096072	410	26-20.49	0.0076623	494	21-51.74	0.0063594
328	32-55.61	0.0095779	411	26-16.64	0.0076437	495	21-49.09	0.0063466
329	32-49.60	0.0095488	412	26-12.82	0.0076251	496	21-46.45	0.0063338
			413	26- 9.01	0.0076067	497	21-43.82	0.0063211
330	32-43.64	0.0095198	414	26- 5.22	0.0075883	498	21-41.20	0.0063084
331	32-37.70	0.0094911	415	26- 1.45	0.0075700	499	21-38.59	0.0062957
332	32-31.81	0.0094625	416	25-57.70	0.0075518			
333	32-25.95	0.0094341	417	25-53.96	0.0075337	500	21-36	0.0062831
334	32-20.12	0.0094059	418	25-50.24	0.0075157			

Explanatory: The table gives the number of sides (251 to 500, inclusive) of polygons, one-half the angle subtended by a side and the sine of that half angle. To get the length of a side of any polygon, of a number of sides included in the limits of the table, multiply the corresponding sine in the table by the diameter of the circumscribed circle.

Table of Sides and Angles of Polygons.

Making Files in a Modern Plant

The Methods and Machinery Used by Henry Disston & Sons of Philadelphia in the Operations of Their File Department

EDITORIAL CORRESPONDENCE

It does not take a very old machinist to remember when machine-cut files were forcing their way against the idea that only a hand-cut file really amounted to anything. But they won out and have come to stay, the hand-cut file being a rarity in these days and the hand-file cutter is decidedly scarce. The material used varies according to the ideas of the makers, the principal conditions being a tough steel of a high grade to take the proper hardening necessary for a good file. Crucible steel is now generally used for the best files.

Henry Disston & Sons, Inc., Philadelphia, Penn., through whose courtesy these illustrations and information were secured, make all their own steel for files and for saws, using the crucible process. Figs. 1 and 2 show the charges of metals ready for the crucible and the pouring into ingots. The steel is then rolled into strips of a proper section for the files to be cut and we come to the file-making department.

Grinding the Blanks

The blanks are now ready for grinding before being cut and go to the grinding room, one of the machines being shown in Fig. 5. These are large grindstones, 6 feet in diameter, running at a surface speed of about 1735 feet a minute and the wheel is moved back and forth across the work by a cam arrangement at the end of the shaft. The blanks are loaded into a holder as shown in the front, held very largely by their tangs, and pressed against the grindstone by the operator. In the case shown the edges are to be ground, the front ends of the files being wedged to make up for the taper in the thickness and to hold them firmly together. Then the holder is turned around so that the edges come next to the grindstone and the whole thing moved up and down automatically. The flat sides are ground in the same way and they are then ready to be cut.

The File-cutting

The file-cutting proper begins in Fig. 6, showing a few machines out of a very large number in order to have them large enough to show details.

The teeth are cut by a chisel operated in a vertical slide which is raised by a cam but has powerful springs above to strike the blow that drives the chisel into the blank and raises the file tooth. The blanks are held on a strip of zinc, perhaps a sixteenth of an inch thick, placed on the bed of the machine. This bed can be inclined to any angle to give the desired rake to the teeth or can be swung sideways to cut the teeth at any desired angle across the face of the file and an automatic feed carries the blank past the cutting chisel as each tooth is cut. When we consider that these machines strike from 2000 to 2200 blows per minute and that every blow means a tooth, it becomes evident that a file is cut in very short order and that the output per day is large for each man or machine.

NUMBER OF TEETH TO INCH.

Regular Taper:	2½	3	3½	4	4½	5	5½	6	6½	7	8	9	10	inches.			
Length per inch...	64	56	52	50	48	46	44	42	42	40	38	36	34				
Slim Taper:																	
Teeth per inch....	64	64	60	58	56	52	50	50	46	46	44	40	38				
Mill Bastard:	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20	inches
Length in teeth per inch.....	56	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	
Flat Bastard:																	
Teeth per inch....	48	42	38	36	32	30	26	24	22	20	20	18	18	16	16	14	

FIG. 1. CHARGES FOR THE CRUCIBLES

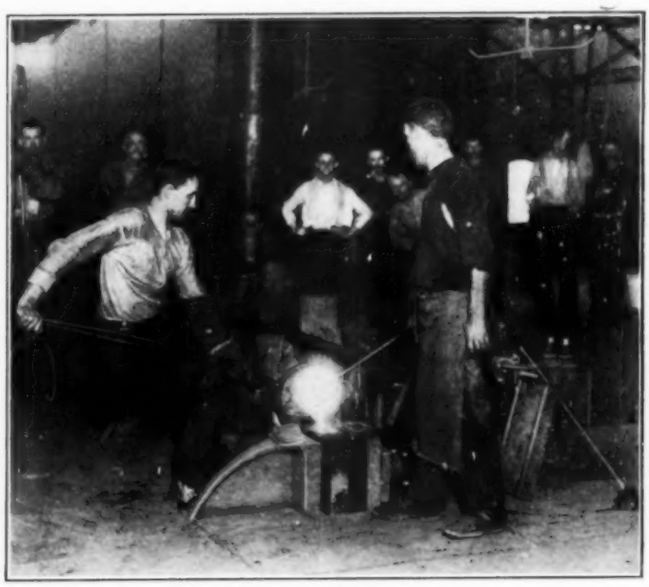


FIG. 2. POURING THE INGOTS

The strips are cut into multiples for the files and then go to the hammers to have the tangs forged down as shown in Fig. 3. Each hammer has its own gas-heated forge. After the tangs are forged the points are forged to size unless they are blunt files. Then they go to the annealing room to remove internal strains and to be made soft for the cutting processes which follow.

Then comes the straightening, which is done by hand as shown in Fig. 4, where

Angles and Spacing of Teeth

The angles of teeth vary with different makers but are usually between 25 and 55 degrees, the latter for the first cuts, which curiously enough are called over cuts and the smaller angles for the second or "up-cut" on double-cut files. While speaking of teeth it is interesting to note that the pitch varies with the size of the file and a 4-inch bastard file may have as many teeth per inch as a 12-inch smooth cut. The table of tooth spaces may be of interest in this connection as representing the practice of the Disston works.

The Stripping Process

The edges are cut first and the files then go to the stripping machines shown in Fig. 7. These have horizontal slides in which files are used to strip or smooth down the burs raised on the sides by the teeth cut on the edges. These files move back and forth over the partly cut files and smooth the sides for their teeth to be cut. On most three-cornered files there are teeth cut on the corners first, then the sides are stripped of the burs, the same as the flat files. A few are made, however, with no teeth on the corners, the side teeth coming together and making a very sharp corner. Then the files go back to have the sides cut.

After cutting, all files are carefully inspected, stamped with the maker's name and straightened to take out any curving due to the cutting of the teeth. Sometimes there is very little bending and at others the files will curve up so as to resemble a new moon.

Making Small Files

One department is devoted to what is known as the Superfine files. These are graded by numbers instead of names, as

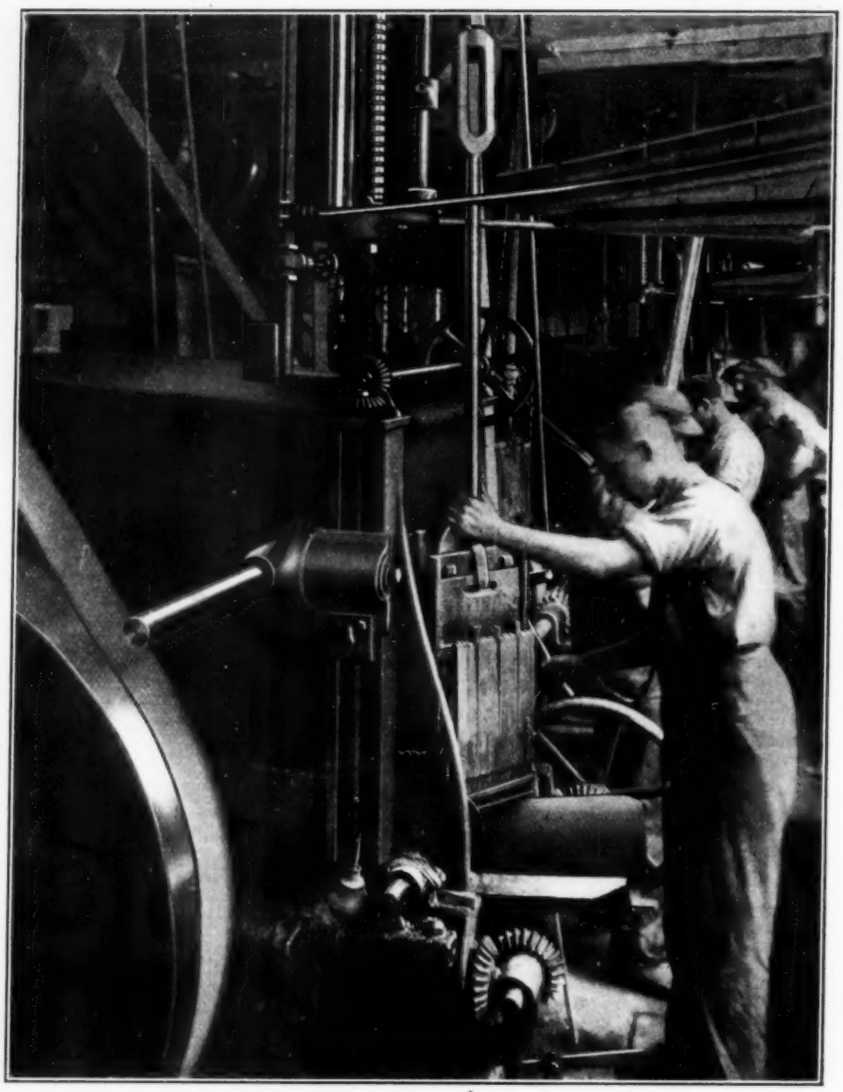


FIG. 5. GRINDING THE BLANKS

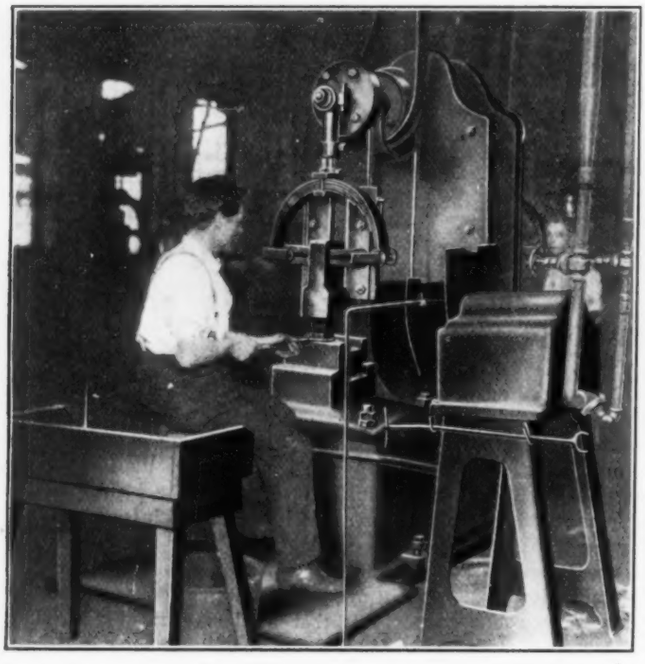


FIG. 3. FORGING THE TANGS

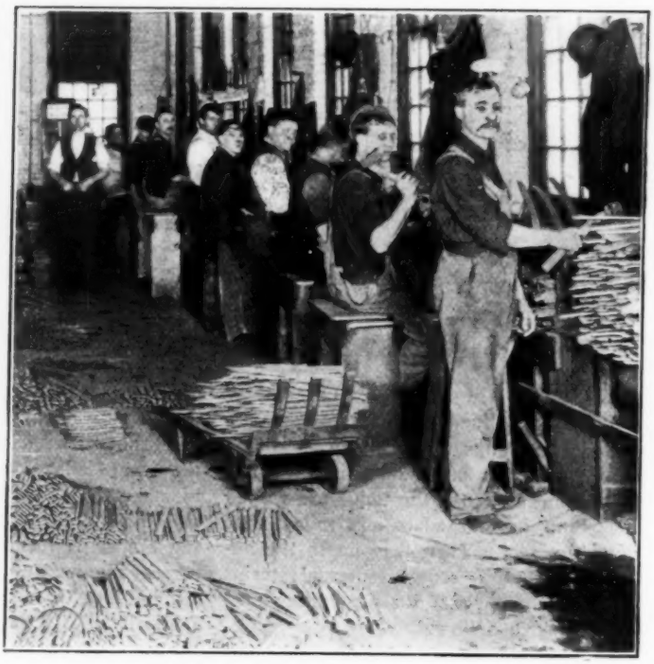


FIG. 4. STRAIGHTENING THE FILES

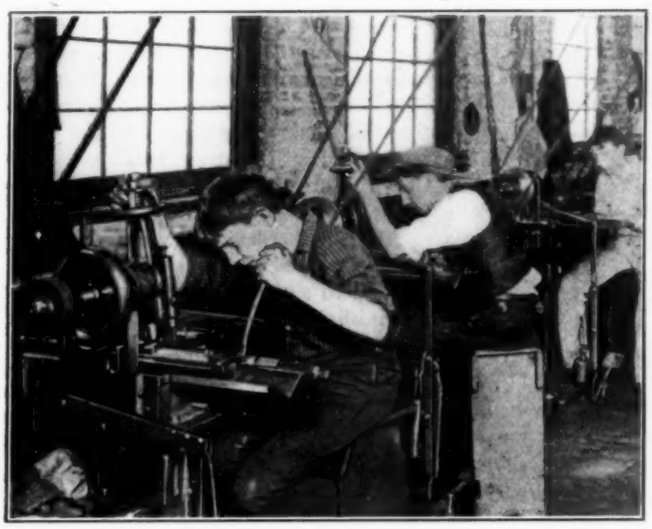


FIG. 8. SECTION OF SUPERFINE DEPARTMENT

FIG. 9. GRINDSTONES IN STOCK

in the old way. These files are made especially for high-grade work and receive the most careful attention all through the making.

Some small, fine files have their teeth made by a process of draw-filing instead of cutting as in regular files. A three-cornered tool with teeth on the edges only is used, and by drawing this over the annealed file blank the teeth are produced very quickly. This is done only on the very small and fine Superfine files, for all others are cut on a machine.

Hardening is the next step in the process, but before this is done each file is "pasted" with a mixture of flour and other ingredients to prevent the sharp points of the teeth being burned in the heating. Lead is used for heating, each file being immersed the required length of time and then dipped in tanks of brine which are kept at a temperature of 90 degrees.

Fig. 10 illustrates the furnaces and the tanks of brine about as well as they can be shown in a view of this kind. The furnaces use oil heating the crucibles of lead, this being a source of heat that can be easily controlled and maintained at a constant temperature, which is necessary for uniform hardening.

After the hardening they are dipped in clean water, put under a mild sand blast or scouring machine to remove all dirt and foreign matter from between the teeth. They are then brushed clean and are dipped in lime water which neutralizes any tendency to rust, then dried by a steam process. Then the tangs are held in a lead bath long enough to draw the temper up to the file itself so as to prevent the tang being brittle enough to break under the strain of filing. The hardness of the files themselves is not drawn in the least.

The Disston company are fortunate in two ways. Their saw department makes a steady customer for their product, using 30,000 dozen a year in this way. This not only makes a market for a large number of files, but also gives them a chance to know at first hand that the files are all they should be. Saw makers have the reputation of being very particular about the files they use and if there should be anything wrong there would be a wail in short order.

The grinding of files and saws uses up a large number of stones and some idea of the number can be had from the number of stones they keep in stock as shown in Fig. 9. Their practice is to run stones for machine grinding 1735 feet and for hand grinding 3658 feet a minute.

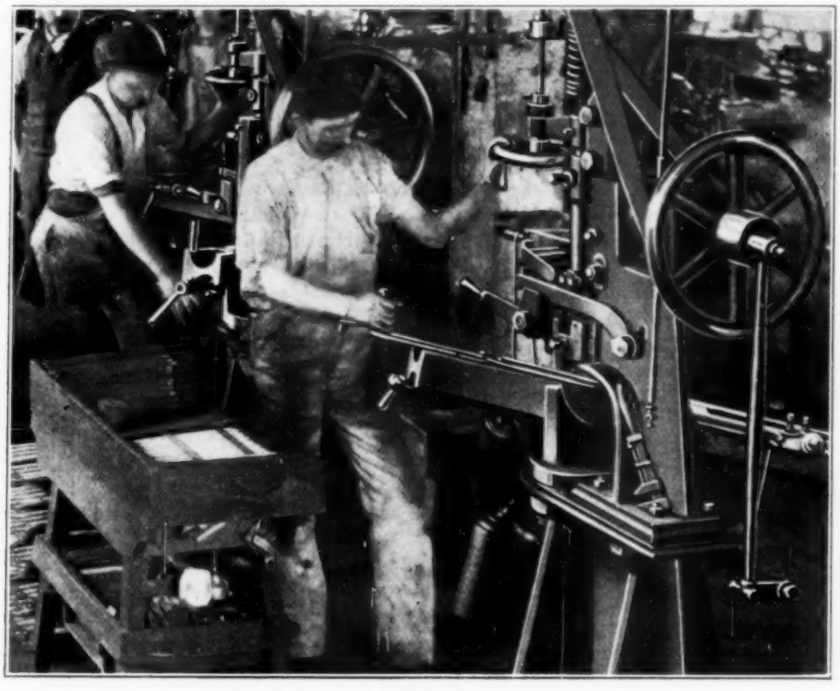


FIG. 6. THE FILE-CUTTING MACHINES

FIG. 7. STRIPPING THE FILES

Toughened Gears for Automobiles

By J. M. Howie

American automobile makers, as a rule, use case-hardening steel for the manufacture of gears. It must be admitted, however, that this process of case-hardening the steel after machining proves to be inefficient and very often costly on account of the extra labor required to eliminate the errors of distortion.

European makers have also experienced this trouble and have made experiments in the use of a special steel which permits of a process of toughening, before the final machining of the teeth. These results are so satisfactory that several makers now use gears treated only in this way, and they proved not only as cheap, but also more quiet running, which is the most essential.

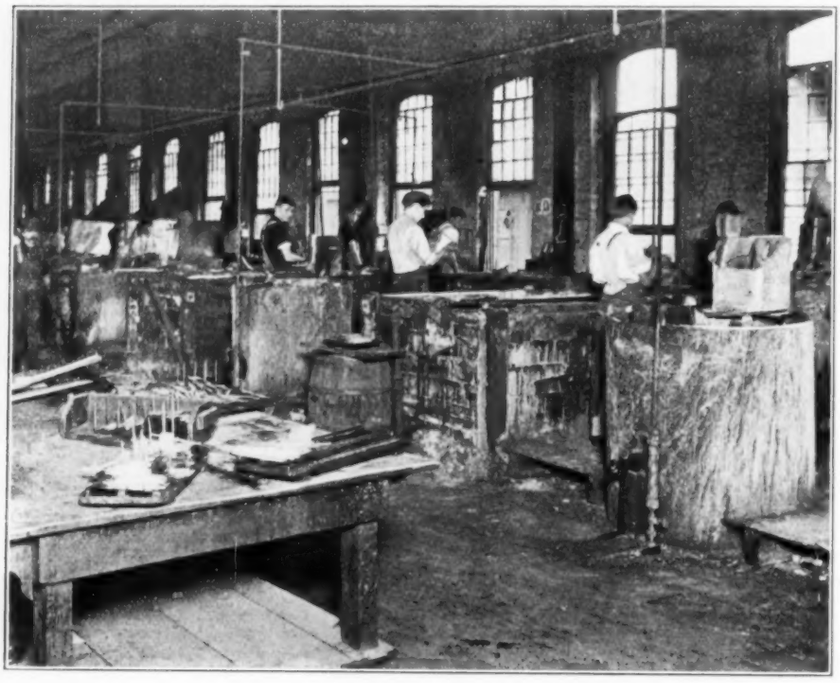


FIG. 10. WHERE THE FILES ARE HARDENED

A general survey of European firms shows that some excellent results have been obtained from a steel known as "Mangano Silicoux" steel, which is commonly used for the springs of wagons and automobiles, and a few notes on the method of treating this metal may be of interest to many readers.

The steel for gears is usually supplied in blanks, or in the bars from which they are cut, and the following gives a few of the principal operations on a blank of this steel when manufacturing gears:

The block is rough-turned and annealed in the ordinary way, and is turned and bored to dimensions, leaving sufficient margin for grinding. It is then roughed, on the gear-cutting machine, leaving about 1/32 of an inch for a finishing cut.

The process of hardening and tempering varies, according to the degrees of hardness required in particular cases, and satisfactory results have been obtained as follows: The blank is heated extremely slow on the plate in front of an ordinary furnace, and then moved inside. As it becomes hotter, it is gradually moved toward the hottest part of the furnace, which should register about 1560 degrees Fahrenheit.

When taken out of the furnace it is placed between two plates, which are shaped so as to follow the contour of the sides of the blanks, and immersed in water at a temperature of 575 degrees Fahrenheit, by means of tongs which grip the center of the plates. The whole is dipped vertically to a good depth and must remain perfectly stationary while immersed. In removing from the furnace to the bath care should be taken not to expose the blank to the air longer than is necessary to place it between the plates.

The second process is the tempering, and is best done by using a lead pot, heated to a temperature of 850 degrees Fahrenheit. The blank is placed in the pot until it is of a uniform temperature, care being taken to have the blank perfectly dry, before placing it in the lead bath. A piece of white wood, such as poplar, or a non-resinous wood, should just char when rubbed on the blank, but should not smoke or blaze. After this process the teeth of the gear should be sufficiently hard to make it difficult to get a grip of the steel with a file.

The blank should then be placed in a cabinet designed to exclude all possibility of currents of air, and allowed to cool off gradually. It will here be noticed that the web of the gear is soft and that only the surface of the teeth is hard. This is one point of advantage in using the plates. They do not allow the web to cool too suddenly, and at the same time the blank will be found to remain much nearer to its original form that when dipped without them.

After the hardening or toughening process described above, the blanks are ground to size and their faces and holes all finished to their respective dimensions. This latter point will be much appreciated by those in charge of the gear-cutting department, owing to the fact that each gear will have true faces, and when two or more are mounted together the chance of straining the arbor when clamping them is small. In case-hardened gears there is often a considerable twist found in gears having thin webs, and owing to the sides not being true, when clamped to the shafts they run considerably out of true. Any twist of these toughened gears, however, is ground out and they are then mounted on the gear-cutting machine, where the final operation, that of finishing the teeth is completed. After this operation, there is no distortion, the piece being a finished gear which is considerably more accurate than is possible with a case-hardened gear.

The most unsatisfactory means have to be resorted to in order to eliminate the errors in the latter and very often the trouble is aggravated instead of eliminated

When the gear cutting is completed the gear is mounted on its shaft and is ready for the gear box.

It is generally conceded that gears cut by this method run quieter and give very satisfactory results. The durability of the gears is also good and after running a short time a glossy scale is produced on the teeth which appears to be as satisfactory as a case-hardened surface.

As this process is followed to advantage by firms who build taxicabs, it should follow that firms who build the class of car for touring purposes could cut such gears with the knowledge that the cost of production is not unreasonable.

The tensile strength of this steel when heat-treated in this manner is from 225,000 to 250,000 pounds per square inch. For differential pinions the same process is used, but with varying temperatures. The following table gives the temperatures for gear and differential pinions:

Gears for Gear Boxes:
(1) Heat to 1560 degrees F. Cool in water at 85 degrees F.
(2) Heat to 850 degrees F. Cool in air.

Rear Axle Gear Bevels:
(1) Heat to 1560 degrees F. Cool in water at 85 degrees F.
(2) Heat to 850 degrees F. Cool in air.

Differential Gears:
(1) Heat to 1560 degrees F. Cool in water at 85 degrees F.
(2) Heat to 850 degrees F. Cool in air.

Differential Pinions:
(1) Heat to 1560 degrees F. Cool in water at 70 degrees F.
(2) Heat to 575 degrees F. Cool in air.

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

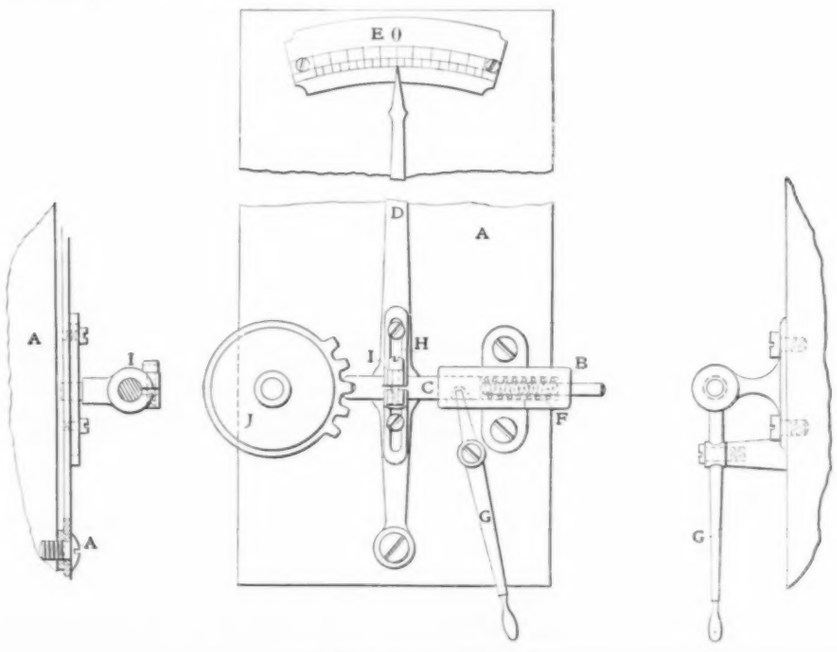
A Gage for Testing Gear Teeth

A gage for testing the truth of automobile gears after they have gone through the case-hardening process is shown herewith. The test is made on a single tooth, and the number of teeth requiring testing is left to the judgment of the person in charge. A high side gear, or in other words, a gear that has a few high teeth, causing the distance from the center to the pitch circle to be a trifle greater than at the opposite side, is marked, and where this gear is assembled with its companion gear if the latter has any high teeth, both are adjusted together to prevent binding when rotating. However, if there is sufficient clearance at the opposite sides of the gears when in mesh to allow a rattle the gears are thrown out. Any of these troubles will show up clearly on the test gage.

In the sketch *A* is a cast-iron plate to which is fastened head *B* carrying contact plunger *C* by which indicator pointer *D* is operated over graduated plate *E*. Spring *F* presses the plunger forward and lever *G* draws it back. Plate *H* engaged by the operating pin *I* which is clamped to *C* is provided with a taper slot to permit adjustment for wear. The rear end of the indicator pointer is pivoted in the manner indicated. The gear is mounted on stud *J*.

The gage end of plunger *C* is fitted to a correctly shaped gear tooth after which it is hardened. A variation of about 1/100 part of an inch can be detected with the device. Gages like this are used for both spiral and spur gears.

Detroit, Mich. D. F. Trow.



GAGE FOR TESTING GEAR TEETH

Novel Drilling Jigs

A subject that seems to call for a good deal of attention in tool design is that of drilling devices for balls and other spherical-shaped bodies, as will be noticed by the number of such devices appearing in the American Machinist.

Fig. 1 shows a jig I designed for drilling a hole in a 3/8-inch brass ball at right angles with a stem already fitted in place, as shown at *A*.

The jig body *B* was machined and bored for the hardened bush shown, the shoulder of the bush being forced against the underside of the top. The bottom of the bush was V-mouthed to facilitate centering of the ball when forced against it. To insure the ball being located correctly the casting was slotted for the stem fixed in the ball.

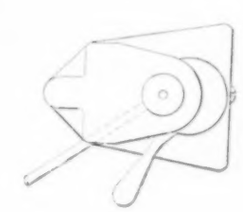


FIG. 1

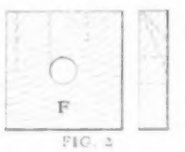


FIG. 2

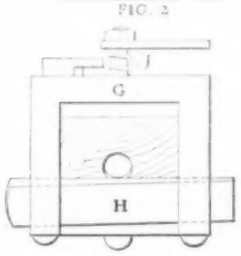


FIG. 3

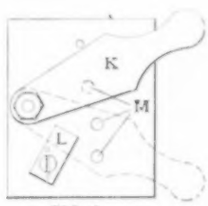


FIG. 4

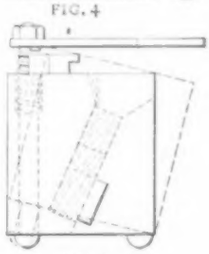


FIG. 5

The clamping arrangement is the part not common with other devices I know of. This takes the form of a wedge whose travel is in a circular path. To get this action the cylindrical pad *C* is provided at one end with a helical surface. The other end is reduced to rotate in the base of the casting and is grooved to receive the end of headless screw *D*, which retains it in place. Fitted to *C* is a handle *E*. The center of *C* is so located that the center line of the bush is close to the edge of the cam or helical surface. Assuming a ball is to be drilled, the handle is swung to the right, thereby providing as much space between the pad and the bush as possible. The ball is held up against the bush and the handle turned back forcing the ball against the bush. To release the work the handle is swung to the right, when the ball falls out and the jig is ready for another.

Another novel jig is shown by Figs. 2 to 5. Hardwood pieces like *F*, Fig. 2, had to have three holes drilled in them, as shown by dotted lines. The positions

of the holes necessitated the wood pieces being held at two different angles for drilling.

The jig body *G*, Fig. 3, was built up to the form shown, the wood pieces being held in by a tapered wedge *H*. Normally the jig is correctly positioned for two holes, and for the other is tilted to bring the bush hole vertical. The jig stands on three feet, two being fixed to the side plates of the body. The third foot is formed on the end of the jig body. The upper end of the rod is fitted with a catch plate *K*, Fig. 4.

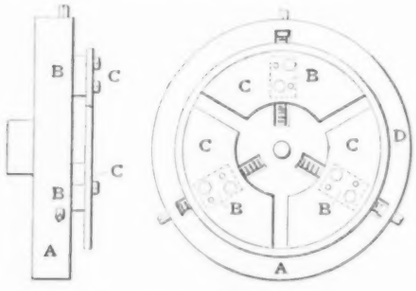
On the top of the jig is a catch *L* and a stop pin. As shown in Fig. 4, the plate *K* leaves two of the bush holes *M* uncovered for drilling. The third hole is covered by the plate. To uncover this hole the catch plate *K* is forced down against the spring and under the catch *L* thus uncovering the hole, and at the same time forcing the rod out the amount the jig has to be tilted, as indicated by the dotted outline in Fig. 5.

This procedure absolutely prevents the drill from being put into the wrong bush, which would be disastrous to the No. 60 drills used. This principle results in a rapid action that could be well applied to other types of jigs.

London, England. W. MADDISON.

Chucking Piston Rings

I saw recently a good makeshift chuck for cast-iron piston rings which had been turned, bored and cut off approximately to width from a long casting. The chuck is used to hold them while they are being finished to width with a double tool. The



CHUCKING PISTON RINGS

front elevation shows the rig with a ring in place and the side elevation shows it without a ring.

A is a three-jaw universal chuck. The jaws *B* have three plates *C* made of ½-inch boiler plate fastened to them with two cap-screws and two dowel pins each. These plates are turned on the outer edge to suit the rings to be operated on. The boiler-plate pieces *C* are, of course, thinner than the width of the finished ring. With this rig the ring is supported nearly all around and the ring is rigidly held. The range of this rig is considerable, a resetting of the jaws and a light cut-off, the periphery being all that is necessary to accommodate a new size of ring, the movable jaws having sufficient range to take care of the clamping.

E. A. DIXIE.

New York, N. Y.

Attaching Paper to Drawing Boards So that There are no Obstructions

I herewith inclose tracing showing a new method of attaching drawing paper

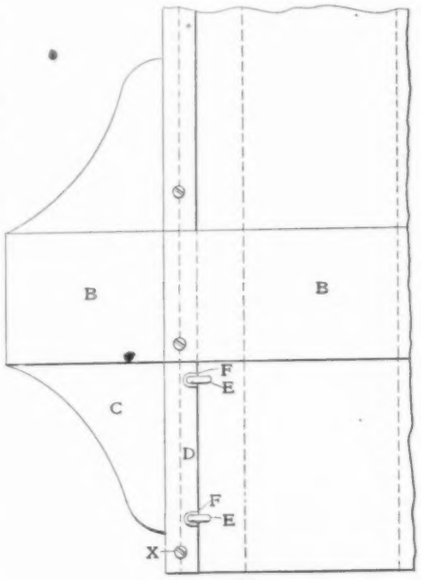


FIG. 1

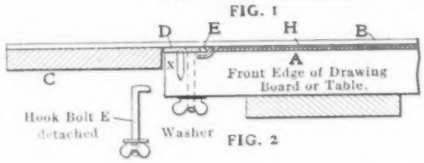


FIG. 2

ATTACHING PAPER TO THE DRAWING BOARD

to a table or board, which leaves the surface free from thumb-tack obstructions and which can be used on the left side only or entirely around the board. Fig. 2 shows the left-hand carrier of a drawing board or table. *A* is the board, *B* is the blade of a T-square resting thereon, with the paper *H* underneath. *C* is the stock of the T-square, *D* is a strip of iron ⅝x⅛ inch let into the table and flush with its upper surface. *E E E* are ⅛-inch hook bolts with thumb nuts. *F F* are notches cut in the drum plate to accommodate the hook bolts *E*. When the edge of the paper is slipped under the hooks and the thumb nuts tightened the paper is securely held and the upper surface is entirely free from obstructions. It is not absolutely necessary to have the iron plates, the hook bolts above will do the work; simply cut out a rabbet in the board and insert the little bolts making sure to have the rabbet of sufficient depth for the bolts to clear the blade of T-square; the iron gives a permanent true edge.

Fig. 3 shows an improvement in drawing boards or tables and T-squares. *A A A* represents the drawing table, *B* is the blade and *C* the stock of an ordinary T-square. *J* is a wooden bar about 1¼ inches wide, which, with the stock of the T-square, should just equal the thickness of the drawing table or board. This bar *J* is placed about 2 inches from the left end of the table so as to bring the outer edge about even with the outer edge of the stock of the T-square. It should project about 3 or 4 inches in front of the table at *M*. This bar is supported and held in position by two pieces of iron ⅛x¾ inch; only one of these pieces is shown at *I*. One end is screwed to the under side of the drawing table and the other end to the under side of the bar *J*. The stock of the T-square rests upon and slides on this bar *J*, as shown in Fig. 2. *K* is a small block of any convenient width about 2 inches long and of a thickness equal to bar *J*; this bar is fastened to the under side of the stock of the T-square by two small screws. To this block is fastened a spring *S*. When properly formed this spring holds the stock of the T-square tight against the end of

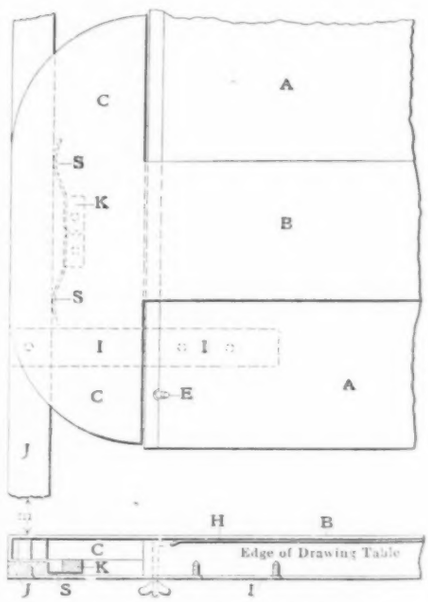


FIG. 3. SPRING-HELD T-SQUARE

the drawing table. This enables the operator to work and use his triangle 4 or 5 feet from the end of the table.

Dedham, Mass. JOHN SWEENEY.

Recent developments in steel-rail making in order to secure rails which will combine hardness and toughness to resist wear and fracture have been with chrome and rolled manganese and from experimental data obtained give promise of satisfactory results.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

The Information Wanted on Punch Press Work

On page 533 J. H. S. asks for information on how to put the stampings back into the plate. In die work of this character the conditions vary with the jobs so it would be very difficult to give a satisfactory answer without a drawing of the particular job in view. You can replace the stampings in the stock and they will stay without any crimping, and they will be in quite tight. It all depends upon the thickness of the stock.

The line cuts show a combination piercing, blanking and forming die, that this trick was used on. The object in this particular case was to use the stock as a shuttle to carry the blanks to the forming die. In this die we make two complete pieces at each stroke of the press.

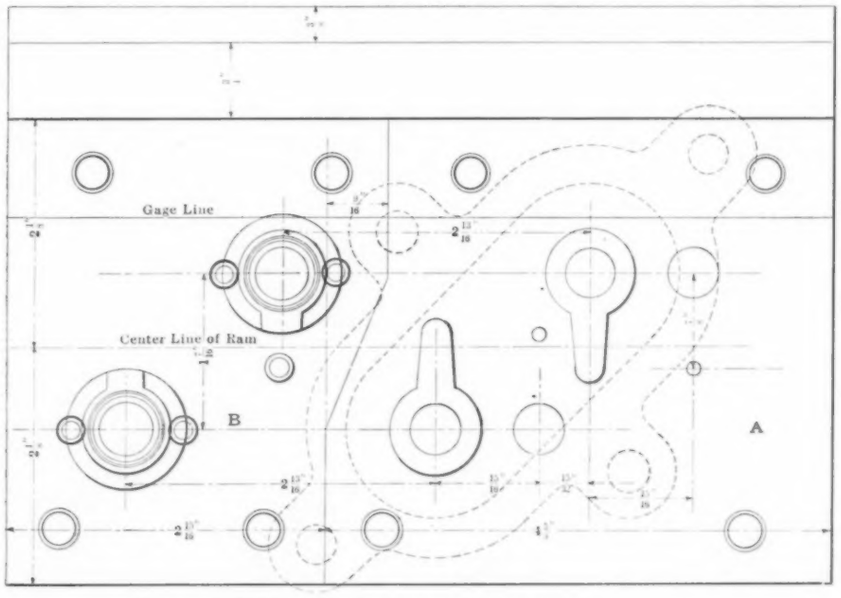


FIG. 1. TOP VIEW OF BLANKING AND FORMING DIE

Fig. 1 shows the blanking and forming die, top view *A* being the combination, piercing and blanking die; *B* the forming die with its face set 5/8 inch below the face of the die *A*. Fig. 2 is a view of the punch shank and punches.

Fig. 3 shows the two dies *A* and *B*, a section of the die shoe and the mechanism for driving the blanks back into the strip. The action of this die is as follows: The stock is fed from the right side to the left. The first stroke of the press perforates; the second blanks; the third stroke drives the blanks into the stock, and the fourth takes the blanks out of the stock and deposits them into the forming die and forms them. After the fourth stroke of the press two pieces are made at each stroke. The operation of replacing the blank in the stock is as follows: The blanking die instead of being open clear through, as usual, is filled with a spring plunger marked *C*. This plunger just comes flush with the top of the die and is adjusted by the nut *D*. This plunger or knockout is forced up by a piece of round rubber marked *E*, the tension of which is regulated by the screw *F*.

The punches have a very strong spring stripper, not shown in the drawing, but made in the usual way, using rubber for springs instead of coil springs. As the punch descends to make a blank the spring stripper acts as a vise to hold the stock, the punch goes on through the blank and as it ascends the blank follows it up, being forced up by the plunger *C*, the stock being held solid with the spring stripper while so doing. In a single-acting press we have not found it possible to force the blank perfectly flush with the stock, but as they are nearly in, the next stroke of the press the spring stripper finishes driving them in as they are caught between the face of the die and stripper.

In this particular case the stock used was only 0.025 inch thick and the blank 15/16 inch diameter. They were in so tight that you could not force them out by hand without bending the stock. The degree of tightness would depend entirely upon the thickness and size of the blank.

To do this job as it should be done it would require a triple-action press, double-acting on the rams and the third action to work the positive knockout from the bottom.

Grand Rapids, Mich. T. C. MASON.

A Peculiar Case of Wear in Gear Teeth

Referring to E. Fergus Duncan's article, on page 273, I wish to give a suggestion for detecting the real cause of the described trouble.

It is a well known fact that nearly all gear wheels with metal teeth rattle when run at high speed. Even if the teeth are practically perfect in form, this disadvantage can be noticed, which has its origin in the vibrations of the wheels and more so when they are seated on the ends of long and elastic shafts. When so mounted they can be regarded as pendulums swinging on their turning axes. And as any pendulum makes only a certain number of movements per unit of time, the wheels also have the tendency of vibrating according to their own conditions. These vibrations can reach such magnitude as to be seen with the naked eye. The vibrating of the wheels is practically eliminated when less elastic materials, such as rawhide or wood, are used for the teeth.

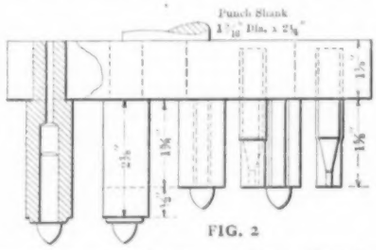


FIG. 2

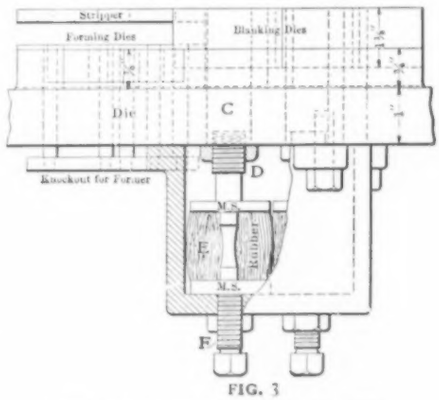


FIG. 3

SIDE VIEWS OF PUNCHES AND DIES

If for some reason it is impossible to use inelastic material for the teeth, the following cases of wheel vibrations can be distinguished:

1. Where the number of vibrations (taken per unit of time) of both wheels is the same as the number of teeth coming into contact. Then the vibrations will grow in length to a certain maximum. Every tooth coming into gear will give a small impulse, which is added to the swinging energy already present until the elasticity of the material absorbs further impulses. Then the vibrations remain constant and the teeth coming into gear will, instead of sliding or rolling on each other smoothly, meet with a blow, which can become of such magnitude that the safe pressure on the teeth is exceeded and abnormal wear will be the consequence.

2. Where the number of vibrations does not coincide with the number of teeth coming into gear. Let, for instance, the number of vibrations be 99 and the number of teeth = 100. Then there will be a period of growing intensity and one of diminishing intensity of the vibrations.

3. Where the revolutions of the wheels do not coincide with the number of teeth coming into gear and, therefore, the vibrations will reach as above a minimum and a maximum, but with the distinction that these two extremes always occur at the same spot on the circumferences of the wheels.

It seems to me that Mr. Duncan's miter wheel belongs to the last described case. If the speed of this wheel had been changed only by a small amount the minimum and the maximum would not have repeatedly hit the same spot of the wheel's circumference, and the wear of teeth would have been less, if the maximum of excessive pressure on the teeth had found at its recurrence a new spot on the wheel's circumference.

CONRAD DEUTSCH.

Winterthur, Switzerland.

Engine Lathe Attachments, and Time Required for Machine Work

On page 379, Fred H. Colvin, in his article on "Time Required for Machine Work," refers to the engine lathe as being somewhat neglected as regards the designing of fixtures and attachments to facilitate rapid production of work.

This is quite true, and cases often occur where an expensive equipment of tools is made to produce a given piece of work which could have been made quite as cheaply on a lathe that cost much less, while the quality of work turned out would be quite satisfactory. I do not mean to infer that the turret lathe has no place, but still, with a good man on the job, the engine lathe is still the king of tools, and is not yet ousted by any of its rivals.

Take, for example, the steel bevel-gear blank, shown on page 98, Fig. 1. This is a most interesting example, which your correspondent has shown in an admirable way, the exact method of performing the various operations, in proper sequence, and the fact of the engine lathe making the best time on the job, shows that "there is life in the old dog yet," and likely to be, despite the advance made in the design of turret lathes during the last few years.

We do a large quantity of the pistons, as shown dotted in Fig. 1. They are first gripped in a chuck bored out at the bottom end and rough-turned. The pin hole *F* is then bored, and the castings are finished on an engine lathe ready for grinding. *A* shows the ordinary face-plate supplied with the lathe. *B* is a casting, which is bored out at the back to fit on the face-plate, and the front end *C* is turned down to be a good fit inside the bored end of the piston, as shown. *D D* are two set screws for securing *B* to *A*, *E* is the eyebolt and nut for gripping the piston up to *B*, by passing over the gudgeon pin *F*. The pistons are turned down to size in the ordinary way and the back rest, shown in Fig. 2, is mounted on the saddle to carry the two comb tools, shown in Figs. 3 and 4, for roughing and finishing the piston-ring grooves.

While the roughing tool is at work, the finishing tool stands out past the end of the piston, but when the rest is moved along it stands out ½ inch farther than the rougher, so that the latter stands clear of the work. These two comb tools are, of course, turned upside down, being at the back of the lathe. We have two old engine lathes fitted up specially for turning these pistons, and it may surprise some of your readers to learn that one operator at $5 per week runs them both, and can turn one hundred complete pistons a week. The turret-lathe men would have to be pretty slick to beat this.

The article shown on page 166, a few weeks ago, on machining a brake-drum lining rings, struck me as being a case of spending money on an expensive equipment, to do a very simple job, which can be done on any engine lathe, with very little outlay in tools. In Figs. 5 and 6 a similar piece of work in gray iron is shown. These are cast in pots, as your correspondent described, bored and turned, then parted, as shown, in lots of 50 at a time. We tried an expensive turret lathe on the job at first, but the times of production, 30 minutes each, was too much for our liking, so we tried them on an engine lathe, with the simple tools shown in Figs. 6 and 7. Fig. 6 is simply two boring bars mounted on the rest at the same time, one boring and the other turning. Fig. 7 is a forked bar for the same purpose. The man actually brought the time down to 15 minutes, and has kept that performance upon every batch since.

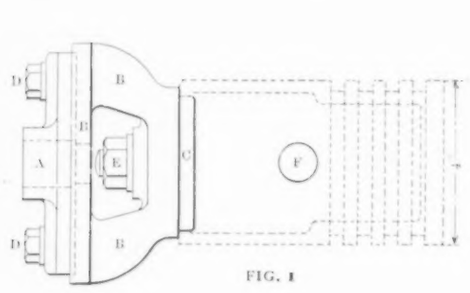


FIG. 1

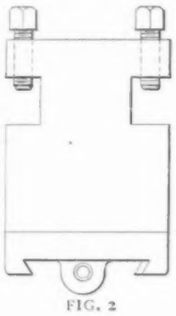


FIG. 2

FIG. 3

FIG. 4

FIG. 9

FIG. 5 FIG. 6

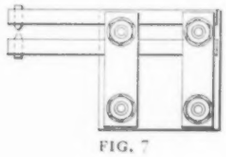


FIG. 7

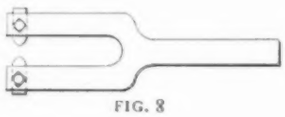


FIG. 8

FIG. 11

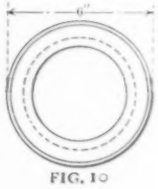


FIG. 10

ENGINE LATHE ATTACHMENTS AND TIME REQUIRED FOR MACHINE WORK

Figs. 9, 10 and 11 (the latter a section) show a threaded gray-iron ring, which we make in batches of fifty, in a similar manner to the previous example. We formerly made these on one of the best turret lathes, with an expert operator of many years' experience on it. The times always worked out at about 65 minutes per ring, on an average.

Being overtaxed one day with work in the turret department, and short in the engine-lathe section, we transferred some of these rings and gave them to a good engine-lathe operator, reminding him of the fact that he would have to compete with the turret lathe if he intended to draw any bonus on the job. He promptly responded by making over double time on the job, and actually bringing the time down to 25 minutes each! The turret-lathe operator was dumbfounded. He could not possibly get near the time made on the engine lathe. We gave him another chance, but to no purpose, and all agreed it was no job for the turret, and the foreman of the engine-lathe section now has that job snapped up every time it comes along.

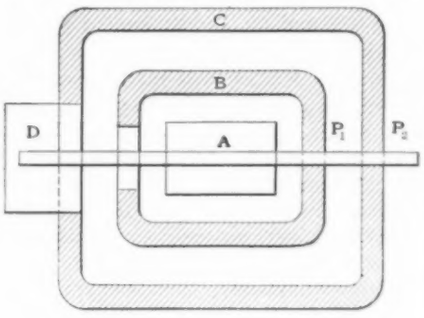
I have seen many other jobs in shops where they seem to have a mania for designing tools for capstan lathes, done on expensive machines, when they could have been turned out in much less time on a simple engine lathe with a bit of forethought, and some simple attachments.

J. T. SAMUELS.

Manchester, England.

A Peculiar Pattern

Referring to the interesting article on page 568, Vol. 31, with the title, "Peculiar Pattern," I would say that I have had several jobs like that. As I understood



SKETCH OF A PECULIAR PATTERN

from the article, they made three molds and three separate castings, one over the other, before it was done. It can, however, be made in one mold and in one casting, as shown in the line cut. For such work we join *A*, *B* and *C* parts together on the points P_1 and P_2. After this arrangement we cast it as one piece, and when the casting is made we divide the parts *A*, *B* and *C* on the lathe.

This requires a good deal of skill on the part of the patternmaker, as the core box must be carefully made to insure an even thickness of metal all around, but where many castings are wanted the saving in time, between making one mold and three, is considerable. The core is made in two halves and these pasted together, and the piece is cast on end so the core print at *D* will support the cores.

Rochester, N. Y. E. MEITNER.

Balancing Grinding Wheels

At page 534, Mr. Schleifer writes that grinding-machine makers should provide means for balancing grinding wheels; this should cause builders of these machines

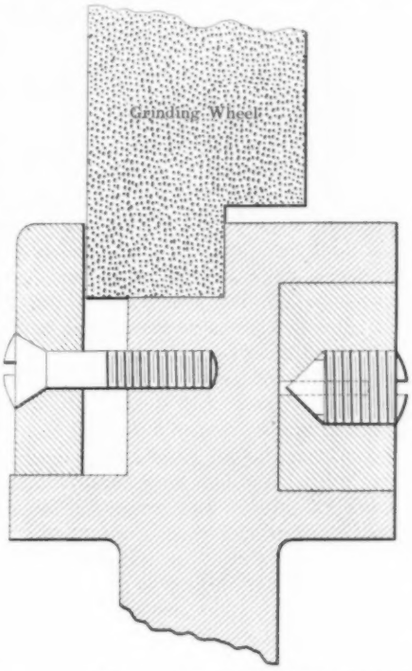


FIG. 1. SECTION OF EMERY WHEEL CENTER AND BALANCING BLOCK

who do not have this feature, to sit up and take notice, but I think this method of balancing wheels rather crude and inaccurate. What would Mr. Schleifer do if he had a wheel which required something more than one of his leaden disks to balance it? While he says the holes are tapered to prevent the disks from flying out after being spread, it looks to me as though heavy grinding would jar them loose and cause the wheel to run out of balance again.

Mr. Schleifer is evidently familiar with grinding, but I do not understand why he apparently has no knowledge of the grinding machines built by Landis Tool Company, Waynesboro, Penn.

For a period of about 10 years this firm has had provisions on the plain machines for balancing wheels; this is partly due to wheelmakers somewhat overlooking this particular point. The emery-wheel center on the above machines, as shown in the illustration, Fig. 1, explains itself, but for the benefit of those not fully understanding this a few words of explanation may not be amiss.

The groove, which can be plainly seen, runs all the way around the center, and is made as large as the center will allow, for the insertion of balance blocks. These being made of cast iron, are split at the bottom, and have a pointed screw running in from the top, which expands the blocks holding them rigidly in any position. Two of these blocks belong to each center, and can be adjusted quickly and accurately to any desired position around the groove (see Fig. 2).

When a new wheel is brought into service and found to run unbalanced after being trued, it is taken from the machine with the center to which it is clamped; an arbor is inserted in the center hole and it is then placed on the balancing ways; the balance blocks are removed and the heavy side located. The blocks are then placed in the groove together at the top (the lightest side) and adjusted so that the wheel stands in any position. Grinding wheels made today by reputable firms are found very often to run unbalanced. In fact, I am safe in saying that more than 50 per cent. of the grinding wheels made today do not run in perfect balance when they leave the makers. I have seen wheels made by the most prominent manufacturers when put on the machine run out of true as much as ⅛ inch at the periphery, and yet the hole run perfectly true and the wheel in balance. After the wheel had been trued it ran so badly that it had to be taken from the machine and balanced; this proved the wheel was balanced before it left the makers, but why they do not always have the periphery true with the hole before balancing I do not know. A wheel running unbalanced can

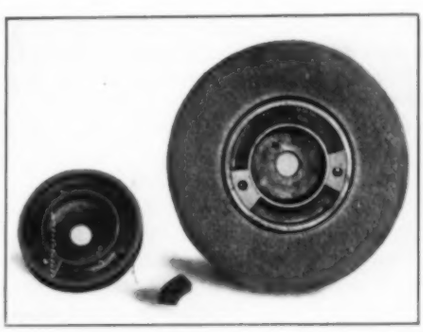


FIG. 2. WHEEL AND CENTER SHOWING BALANCING BLOCKS

never be turned true running at its cutting speed (about 6000 feet). If a wheel is found to run unbalanced I would advise taking it from the machine at once after truing and placing it on the balancing ways.

It will be found that wheels are somewhat out of parallel, that is, the sides vary in thickness. There are no reasons why wheels cannot be made more parallel (if a diamond is used in machining), as well as any piece of metal turned in a

lathe. It looks to me as though diamonds are not used as much as they should be by wheelmakers. A grinding wheel thicker on one side causes defective work, and should be made parallel before grinding, and I might add, that if grinding wheels were machined true, they would give less trouble to the user.

Referring to the question of proper wheels for tool grinding, the American Emery Wheel Works, Providence, R. I., manufactures a silicate wheel 46 grain, grade 2, which I have found to be excellent for all-round tool grinding; they are very sharp, cool cutting, and seem to cut faster than any vitrified wheel I have ever used, and there is really no danger of drawing the temper.

Waynesboro, Penn. J. H. HOLLINGER.

How Should a Boy Go About Becoming a Mechanical Engineer

As this letter appears (on page 710) in the AMERICAN MACHINIST I will assume that by mechanical engineer Mr. Watt means a mechanical engineer who has charge of the production of articles made chiefly of metal; whether these things be engines, machine tools or only metal specialties does not make much difference.

To be a successful mechanical engineer of this kind a man must know his materials and how to handle them. One of the most important, if not the most important, and at the same time most elusive, difficult to handle and fickle materials the mechanical engineer has to deal with is the human material, the man behind the lathe, miller or planer. The true nature of the man in the shop is not shown to the technical graduate, whether he is serving his apprenticeship or is working in a drawing office or as assistant foreman, picking up the elements of the practical end. The only way for young Watt to know the men, (he will later on employ) is to work with them at a time when he knows less than they do. If he has his eyes and ears open he will get at their method of thought. He will know what appeals to them and how to handle them. One thing he will find out is that the average good mechanic has little respect for the mechanical engineer who does not know the practical end, but that his estimation of the mechanical engineer who is on to his job, who knows the practical end as well as the theoretical end is such that he will in many cases sacrifice himself rather than have an error of judgment count against the practical mechanical engineer. This I have seen not once but many times.

Until a few weeks ago I would have said, "let the boy serve his apprenticeship first" but I have had my ideas modified by reading the Cincinnati plan which is in brief to carry on the two together or rather alternately i.e., two weeks in the shop and then a fortnight in the school.

The average mechanic does not take kindly to the technical graduate entirely ignorant of shop work or worse still the one who has played at making paper weights in the college shop. My own experience was this: I had taken courses in two European universities, not with a view to being a mechanical engineer, but leaning toward the broader education which is considered *the* thing over the water. A smattering of half a dozen languages, including two *dead* ones, a little chemistry not applicable to anything in particular, sufficient mechanics, physics, botany, mathematics and other more or less useful studies to scrape through exams on. If I had gone unwarned to serve my apprenticeship I know I would have been a flat failure. A friend who had been through the mill cautioned me to be very careful not to display any signs of education until asked to do so. I refrained from thrusting my erudition on the men, made friends with them and soon found that there was quite a lot to be learned from them which I could not find in Rose's "Modern Machine Shop Practice."

I think if I had a boy who wished to become a mechanical engineer and I was unable to let him follow the Cincinnati plan I would get some friend with a shop a hundred miles or so away from home to give him a job as an ordinary apprentice for say two years with the distinct understanding that there would be no favoritism shown, that the boy should have the business rubbed into him pretty hard. If they didn't kill him in two years and he still liked the business then I would let him go to college, and after finishing up there I would let him go back to the shop again for say a year. The two years in contact with the men would give him a line on them. The two years in contact with actual work would give him a line on professors and textbooks and might save him from absorbing some useless information. After his term in college was over if he went back to the shop he would be welcomed as one of the boys because he had been there, and would receive a little extra attention because he had shown that a boy out of the shop could hold his end up in the college. If he took up the office end of the business his two years' contact with the men would stand him in good stead, enabling him to see things from their point of view.

New York. E. A. DIXIE.

James Watt asks the above question in a very interesting manner in your issue of Nov. 12, referring especially to a boy of 14, who "imagines he wants to be a mechanical engineer." The original Watt it is said, went about it first by observing his mother's tea kettle, and afterward became a mathematical-instrument maker in the University of Glasgow. He did not know much about steam or about how a cylinder should be bored, in his early days, but he had the kind of mind that wanted to know, and after many years of patient labor he became a pretty fair sort of mechanical engineer. The original Fulton was an artist and did not know much about how a steam engine should be built, but he knew enough to buy one from Watt, instead of trying to build one, which in itself was a pretty good kind of engineering.

A says, "let the boy go to college first;" B says, "let him serve his apprenticeship first, and then go to college." Well, either way is good, it depends on the boy, and also on his father. If the boy has the right stuff in him he will come out all right whichever thing he does first. If the boy is only 14, there is no need of his deciding this question for three or four years yet. Let him go to the high school and study English composition and public speaking (that is how to *do* things in English, not merely read about them) mathematics and physics and chemistry, and a few other things to fill in, and when he is through he may imagine he wants to be something else than engineer.

It depends on the father. Assuming that the boy is 18 when he is ready either for college or the apprenticeship, and that it will take four years of college and three years of shop to make an engineer out of him, which shall he take first? If he takes the shop first, he will not earn more than enough to pay his board during the three years, and will have saved nothing toward paying his living and college expenses, so he will have to be supported by his parents until he graduates at 25 years of age; whereas if he goes to college he can be turned out to earn his own living at 22. If he takes the Cincinnati plan he gets out at 24, the combined course taking six years, but he is earning money all the time. The financial argument is entirely on the side of the Cincinnati plan, but think how much fun the boy misses. He is at work all the time and has no time left for foot-ball and for loafing around the fraternity house.

A says, "a mechanical engineer need not know the little things, how long it ought to take to turn or plane or bore a certain job;" B says, "he should know these things, and be able to say this job should be milled, that one planed, etc." Both are right, but with limitations. He does not need to know these things unless he needs them for actual use, and not one mechanical engineer in ten ever really needs them as part of his special outfit. He can get them from someone else if he needs them only once in a great while. If he is the time-setting boss, or whatever is his title in the Taylor system, he must know them; that is his business, which it has taken him years to learn, but if he is only a designer in the same shop, for instance, he does not need to know them, for he can get them when he needs them, from the time-boss, and they will be right up to date, with the most modern improvements.

A says, "estimating is an exact science;" B says, "it is guessing;" both are right,

it is both. A number of machines are to be built. The estimator with scientific exactness figures from the drawings the weight of each casting and forging. The time-setting boss can tell him exactly the labor cost of each machine operation, on the piece-work system. Then the estimator guesses how much should be added to this particular job for "burden," what the percentage of bad castings will be, and how much labor will be lost on account of them, and how much it will cost for assembling, for which part of the work he has no data.

A says, "records of work done are of more value in estimating than actual experience." I don't know what he means. Records of work done are records of experience. Experience is of no use in estimating, unless it is recorded somewhere, either in someone's memory or in a record book. The first place is good, the second is better, both places together are better still. B says, "how about new jobs for which there are no records." That is an easy one. Resolve the job into its several elementary parts. Estimate closely each part that is like work done before, so many feet of planing with such a feed and depth, etc., and guess the parts for which no one in the shop has either records or experience.

Syracuse, N. Y. ROBERT FULTON.

[There have been a number of contributions to this discussion which for lack of space we are unable to print. Of these 75 per cent. are in favor of the apprenticeship preceding the college course, 25 per cent. are in favor of the college course preceding or alternating with the apprenticeship. One hundred per cent. are of the opinion that the more the mechanical engineer knows about shop work the better fitted he will be for his profession. —ED.]

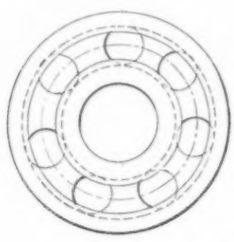


FIG. 1

FIG. 2

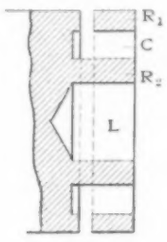
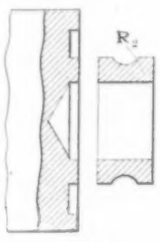


FIG. 3



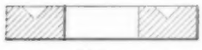


FIG. 4

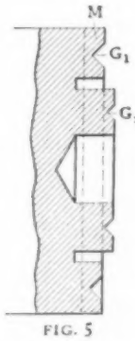


FIG. 5

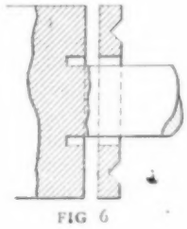


FIG 6

SAVING MATERIAL IN TURRET LATHE WORK

Saving Material in Turret- Work

The article on page 601 entitled, "Saving Material in Turret-lathe Work," would be of additional interest if the form of tool used had been shown.

It is well known that for 20 years and more the hollow cutter has been used for making rings, etc., of brass or other soft metals, but in the use of hollow cutters on high-carbon steel for the manufacture of annular bearings there are certain difficulties which hinder a satisfactory operation, chief of which is the very small section of cutting blade that can be allowed.

I reproduce the cuts on page 601; the straight cut *C*, Figs. 1 and 2, is usually equal to half the diameter of the ball. The average bearing seldom uses a ball larger than ⅜ inch diameter, so it is evident that the cutting blade, corresponding to the blade *C*, cannot exceed 3/16 inch in thickness; the blade is of necessity backed off sharply for clearance, thus leaving an extremely light tool with which to tackle high-carbon steel, but very good for brass. Now if the cut is of much depth, and it must be at least twice the diameter of the ball, there will be trouble with chips, especially at the center bore *L*, which is of comparatively large diameter. This all necessitates backing out to clear away the chips.

We make ball bearings commercially, and our superintendent gave this scheme a trial some time ago: The hollow cutter was made with three blades correctly designed and ground. Owing to the light section of the blades there was a slight springing motion during the cut which caused the groove to take a wavy, irregular contour not at all concentric, and very soon resulted in breaking the cutter. Only a very light feed could be used at the best, and it was found that the additional time required to nurse through a cut more than balanced the difference in cost when using two sizes of bar and scrapping the center.

We would like to hear from anyone who has found this scheme feasible on bearing work, and referring to Fig. 6, we are curious to know what "special arrangement" will produce the form of cut shown.

Rochester, N. Y. RALPH W. DAVIS.

Uses for Lifting Magnets

In the article on lifting magnets on page 619 of the AMERICAN MACHINIST, E. F. Lake, in speaking of them states that: "The single limitation to the magnet's field of usefulness is in the fact, that the objects to be handled shall possess magnetic qualities." In this, I think, he did not render full justice to the whole of the magnet's usefulness, for I remember having seen, within the current year, a magnet in the act of lifting a glass panel, by simply acting on a piece of iron that was placed on the lower face of the panel, and it would be just as easy to use a magnet in this way, for lifting any kind of nonconductive material.

There are two cases where the magnet can be used on nonmagnetic materials: First, the material to be handled may consist of small parts, such as screw-machine work in bronze, copper details of electrical apparatus, etc., which have sometimes to be carried around the shop in large numbers. These may be placed in a sheet-steel box of sufficient weight, and carried by the magnet as easily as a casting of iron. Second, the material may come in large pieces, like glass panels, copper sheets, spools of copper wire, etc. Those can be handled by placing steel straps or plates underneath them, if their thickness is such that it does not bring the steel out of the influence of the lines of force emitted by the magnet. The limit attainable depends on the shape of the magnet and its consumption of current. And yet, special straps might be made, for any special work, that would permit the use of magnets.

Another form which may be given to lifting magnets and prove useful is the one of a vertical endless belt. This is merely a suggestion, as I do not know of anything made in this line. As I see it, it would be an endless chain, steeply inclined or vertical, rendered active or cut off at certain points of its path, so as to allow the taking or releasing of castings or boxes of small parts at any given floor in a building. This may be rendered safe by security attachments and would do away with elevators for castings, or even for finished parts.

Erie, Penn. P. FENAUX.

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Dec. 10	18,750
Dec. 17	18,750

This paper reaches 33,000 *separate readers each month and* 18,750 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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Alcohol as a Fuel for Small Isolated Engines

In spite of the fact that there is much less enthusiasm today, in regard to alcohol as a fuel, than was manifested during the period immediately preceding the repealing of the tax on denatured alcohol, as an engine fuel alcohol is worthy of consideration under certain conditions and in certain localities. The reason for its failure to come into general use is undoubtedly one of cost. At present it does not appear that alcohol will produce power as cheaply as gasolene where the latter can be obtained easily. In regions remote from the centers of production and distribution of gasolene, alcohol may be at a distinct advantage as a fuel.

In this connection there has been brought forward an interesting speculation as to the fuel of the future, that is for the remote future when our present liquid fuels shall have been exhausted. It has been pointed out that alcohol can be made from an immense variety of vegetable growths, and from this source will always be available as a fuel for power and other purposes. Thus the field for the improvement of engines to use alcohol exclusively is a legitimate one.

In regard to the performance of small isolated alcohol engines, the Department of Agriculture has published a bulletin dealing with the use of such engines among farmers; one section of this deals with the use of such engines among the farmers of Germany. The original investigation was carried on by Professor Strecker, of Leipzig. The information was obtained by means of a circular letter sent to 120 German farmers who had been using steam engines, but had replaced them with alcohol engines. These 120 engines were of three different makes and ranged in size from 6 to 25 horsepower.

From the tabulated data we find the following statistics of interest: Forty-six per cent. of the answers ranked the alcohol engine equal to the steam engine; 47 per cent. considered it superior and only 4 per cent. considered it inferior. The coal consumption for the steam engines was 0.55 pounds per brake horsepower-hour with an addition of 100 pounds per day per engine for starting. The price of coal averaged $4.47 per ton. Two kinds of alcohol were used for fuel; the one a German denatured alcohol, the other a mixture containing 20 per cent. benzole. The number of users were in the proportion of 19 to 81, respectively. The alcohol consumption ranged from 2.35 pints per brake horsepower-hour to 0.92 pint, with an average of 1.22 pints. The cost of the denatured alcohol averaged 15.2 cents per gallon and of the benzole mixture 16.11 cents per gallon. Almost invariably gasolene was used for starting. After taking all of the items into consideration, it was found that for a 10-horsepower steam engine operating 1000 hours per year, the fuel cost averaged $240. For an engine using alcohol the fuel cost was $253.

Turning to the question of maintenance, 57 per cent. found the maintenance cost less for the alcohol engine than for the steam engine; 34 per cent. reported no difference and 9 per cent. found the alcohol engine to cost slightly more.

Another interesting point that was brought out by the inquiry was that the alcohol engine is capable of operating in all kinds of weather. In some cases it was reported as having been used in a temperature of 18 degrees Fahrenheit below freezing; requiring, however, a little longer time to start up. An important point brought out by the investigation is that there is absolutely no difficulty in instructing the ordinary person in the proper method of handling and operating alcohol engines. An estimate of the number of such engines in use in Europe today is difficult to obtain, although one authority places it at between 5000 and 6000 in Germany alone.

In this country there is another obstacle besides the cost that is retarding the use of alcohol fuel. It is the attitude of engine builders in general. Any engine on the American market today which can operate with gasolene or kerosene can operate with alcohol fuel without any structural change, provided it receives proper manipulation. Yet engine builders seem to be indifferent to the introduction of alcohol engines, and while they are quite willing to give guarantees in regard to gasolene fuels, they are not inclined to give similar guarantees for alcohol fuels. This condition is unfortunate, to put it mildly, and can be defended only from the standpoint of supply and demand; for as soon as the demand for an engine especially adapted to use alcohol as a fuel is sufficiently insistent, that engine will, of course, be developed.

The Electric Motor—Advantages That Are Little Appreciated

Most of our readers are familiar with the stock arguments in favor of electric motors for driving machinery in industrial establishments: cleanliness, absence of long lines of shafting, better power gradation with reference to factory output, etc. There are, however, a few features that are not so generally understood or appreciated, one of these being the inherent property of the motor to indicate changes in the working condition of the machinery which it drives. For example, if the no-load current of a motor direct-connected to a machine of any type has been three amperes right along for weeks or months, and changes to four amperes, it is safe

to conclude that the machine it is driving needs investigation. Of course, the increase in no-load current may be due to trouble in the motor itself, but if it is, the trouble will manifest itself in other ways also. When a motor is used for group driving, it serves as an excellent means of indicating the condition of the shafting and bearings. Should the bearings wear or be carelessly adjusted out of true alinement, the increased friction load will be indicated by a meter in the leads to the motor. In view of this feature, it is a good plan to keep a record of motor intake under all conditions when an installation is first started up and at regular intervals thereafter, whether the motor be used for group or direct driving.

Another valuable feature of the electric motor is its ability to indicate the power requirements of a machine both as to the necessary capacity of the driving motor and as to peculiarities in the torque characteristics of the driven machine. For example, if a trial motor be coupled or geared to a machine which requires fourteen horsepower during one-third of its operating cycle and eight horsepower during the other two-thirds, an indicating wattmeter in the motor circuit will show this, and a simple calculation will suffice to determine that a ten-horsepower motor provided with a suitable flywheel will drive the machine without difficulty.

Another advantage, and one which is indispensable in many instances, is the ability of an electric motor to start up with a heavy load or overload. A steam engine will also do this, but unless it is a compound it will be more than likely to stall on the first dead center; however, the day of steam plants comprising a plurality of small engines is over, and this leaves the electric motor unapproachable in its ability to start up with a heavy handicap.

The Publication of Comparative Tests

We regret to notice the publication in the *Journal* of the American Society of Mechanical Engineers and the reading at the recent meeting of two papers containing the results of comparative tests of competing commercial machines without in either case, apparently, the consent of all parties interested.

We regard this as a thoroughly indefensible practice—so indefensible, in fact, that we are unable to understand how these papers could have passed the scrutiny of the secretary's office, and this regardless of their merit or of the value of the facts disclosed by the tests.

In one case the reading of the paper was followed by a protest from a representative of one of the manufacturers who claimed that he had been given no opportunity of being represented at the tests, and he couched his perfectly proper objections in language which would not look well in print. In justice to him his protest should appear with the paper, albeit its appearance would be a distinct blemish on the *Transactions*. In view of unfortunate situation the whole matter may, of course, be suppressed from the *Transactions*, but that does not correct the harm done by the publication of the original paper in the *Journal*.

Material of this kind would not be printed in any well edited technical paper, nor will such papers, we believe, reprint such tests after they have received the sanction of the society; and, while the relation of the society to manufacturing interests is different from that of the technical papers, we regard the difference as one which should increase rather than diminish the scrupulous care involved in the editing of the society's *Journal*. Mechanical engineering is so intimately associated with manufacturing and commercial interests that the connection offers many embarrassments to the publication committee, but we regard it as an axiom that the society should not publish the results of comparative tests of commercial machines without the consent of all parties interested.

New Publications

How to Build Up Furnace Efficiency. By Jos. W. Hays. 46 3½x6¼-inch pages. Publisher, Jos. W. Hays, 601 Hartford Building, Chicago. Price, 50 cents, postpaid.

We have seldom seen a pamphlet on an engineering subject filled with more pertinent questions, more clearly drawn deductions and more useful suggestions. The definition of an efficient furnace is given thus: "That furnace is the most efficient which completely consumes the combustible with the least surplus of air." In order to test furnace efficiency, the use and application of the following instruments are described in detail: The hand gas-testing instrument and the automatic gas-sampling vessel; the automatic CO_2 indicator and the automatic CO_2 recorder. With these instruments air leaks and air infiltration can be located and measures taken to stop them. A few of the questions are: "Should the draft be regulated by the damper or the firedoors?" "Are the fires too thick or too thin?" "Should the coal be fired dry or wet?" "What is the heat value of your fuel?" "Have they 'changed coal on you?'"

A perusal of this little book by shop managers, superintendents, engineers, and in fact, all who are directly responsible for the results from the burning of coal should be of interest and profit. The style in which it is written is very readable, and it is entirely free from undesirable technicalities.

Bibliotheque de Mechanique Appliquee et Genie. Locomotives a Vapeur. By Joseph Nadal. 320 4½x7-inch pages with 71 illustrations in the text. Published by Octave Doin. Paris. Price, 5 francs.

This work deals with the locomotive development of the last 20 years, and is divided into five chapters. The first deals with the boiler and firebox, the second with the wheels, springs, frames, etc., and the third with details of the mechanism. In Chapter I there is a study of the results of the locomotive experiments that were carried on at St. Louis. Chapters IV and V are more theoretical in their treatment and contain much mathematics. Chapter IV treats of the stability of locomotives in motion and of the influence of different locations of the cylinders, the action of the driving wheels, oscillations of the springs, etc. Finally, Chapter V treats of the horsepower of locomotives and of the relative advantages and disadvantages of the various methods of using steam; that is, by single expansion, compound expansion and superheating. The different types of locomotive are also discussed.

Personals*

G. F. Wilson, of the Prentiss Tool and Supply Company, is at present away from business on sick leave and is convalescing at Pinehurst, N. C.

William Kent of the Pocket Book, goes to the Sandusky Foundry and Machine Company, of Sandusky, Ohio, January 1, as general manager.

James H. Collingham, formerly of the American Locomotive Company, is now traveling for the Standard Machinery Company, of Providence.

A. W. Richards, special representative of Manning, Maxwell & Moore in Japan, and who has been in this country several months, expects to return to Japan the middle of January.

John K. Lencke, managing director, Pneumatic Tool Company, St. Petersburg, Russia, who has been in this country studying improved shop methods, sailed for home December 13.

Henry Aiken

Henry Aiken, a well known mechanical engineer, died at his home in Pittsburg on December 8, aged 66 years. Mr. Aiken came to this country from Ireland when but a child, and selected as his life work engineering. He subsequently specialized on iron- and steel-work construction, and has originated during the last quarter century many improvements in the methods of production adopted in the iron and steel industries.

*Items for this column are solicited.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

A Modern Lifting Magnet

The Electric Controller and Manufacturing Company, Cleveland, O., has been at work on improvements to their magnets both in the direction of dependability and in increased efficiency in the handling of material. This has resulted in their bringing out a new magnet called type S. A. which is illustrated and described herewith.

Unquestionably a successful lifting magnet must withstand in service more severe abuse and rough handling than any other type of electrical apparatus. In operation it is suspended from the hook of a crane, which is frequently not equipped with a lowering brake and therefore, may be dropped at high speed upon the material to be lifted. This may be comparable almost to dropping the magnet from a second-story window. In service it will be swung against cars, charging boxes, piles of pig iron, etc., and must be capable of withstanding the blows and shocks which result. It must operate under all weather conditions, day or night, irrespective of rain or snow, and its insulation must withstand a voltage much higher than line voltage, due to the inductive kick which occurs when the circuit of the magnet is opened. Its winding must not be injured by the large amount of heat which is necessarily generated within it, but preferably also should not be damaged by external heat when the magnet is called upon to handle hot material.

In Fig. 1 will be seen a cross-section of the type S. A. magnet which shows the arrangement of parts that by experience has been found to meet the severe and exacting requirements of service. *A* is the body or framework of the magnet, which is an annular casting of special electrical steel heavily ribbed on both its upper and outer surfaces. The ribs add largely to the surface for dissipating heat; stiffen the magnet case mechanically and add to the cross-section of the magnetic circuit. *B* is the core of the magnet which is surrounded by the winding *C*, composed of a series of coils each wound with a conductor in the form of a copper ribbon or strap, the turns of which are insulated with asbestos ribbon. The coils are wound upon a heavy brass form *X* which resembles a spool with one head removed.

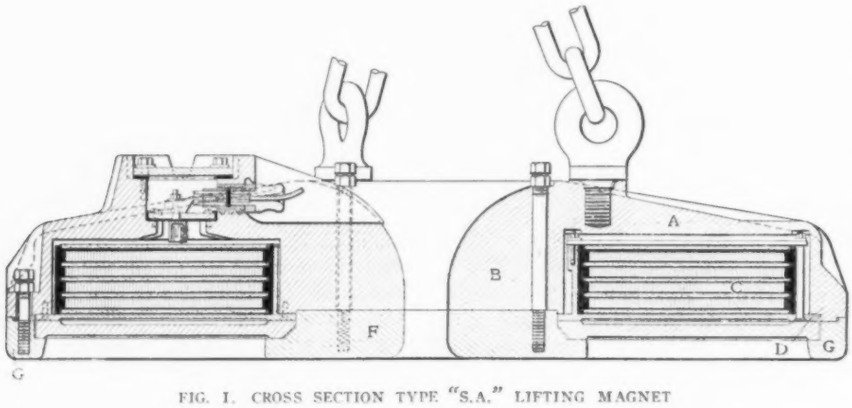


FIG. 1. CROSS SECTION TYPE "S.A." LIFTING MAGNET

Outer and inner flanges *D*, *G* and *E* are provided, being carefully finished and engaging with finished surfaces on the inner and outer pole faces of the magnet case, thus completely sealing the lower face of the winding chamber, a water-tight joint being insured by clamping the flanges in place with screws.

With the winding thus assembled in the magnet case the lower face of the coil is covered by a heavy plate of nonmagnetic manganese steel, which in turn is held in place by pole shoes *F* and *G*. A manganese steel was found which answered the purpose admirably, it being both hard and tough and at the same time practically nonmagnetic.

The arrangement of terminals also deserves attention since, if this be weak, trouble is certain to result from this cause. The terminal cavity is surrounded by raised walls, cast integral with the magnet case and of such thickness as to be as strong as the magnet case itself. It is closed at the top with a heavy steel cover, which seats against a gasket to form a water-tight joint, and is firmly bolted in place, the heads of the bolts being protected from abrasion by the walls of the

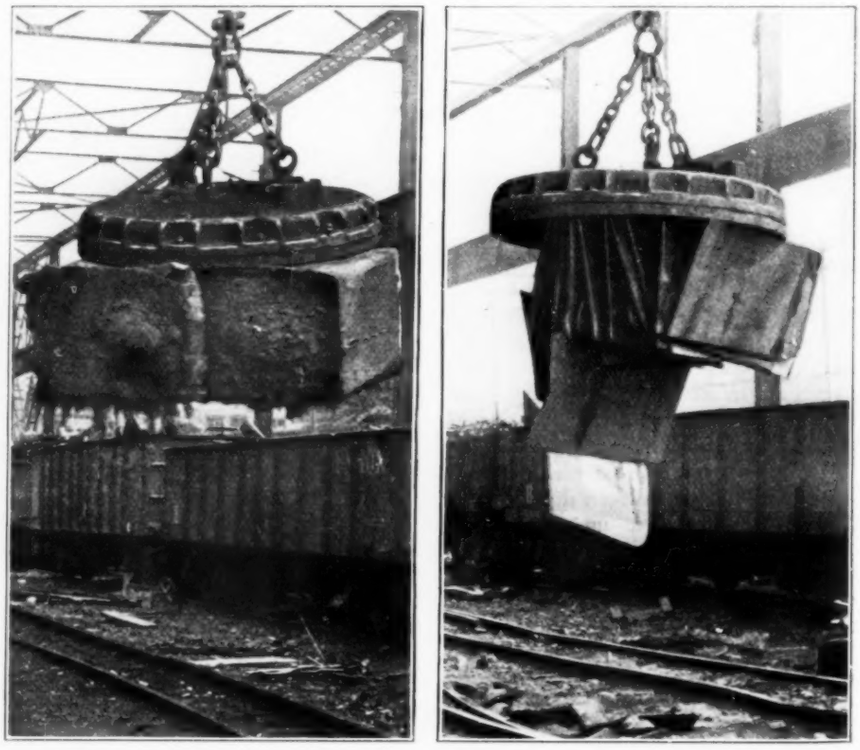


FIG. 2. TYPE S.A. MAGNET LIFTING 2 INGOT BUTTS AND PLATE SCRAP

terminal cavity. The terminals themselves are of the plug type which permits of quick attachment and detachment of the service wires.

The best proportions for securing maximum efficiency in handling the largest amount of material in a given time with a minimum total consumption of current has been the aim of the designer. A 40-inch magnet lifts substantially as much as older forms of magnets, that were 50 inches in diameter, with practically the same current consumption, although it weighs 2000 pounds less. Comparing the performance of the two magnets on a 5-ton crane having a 25 horsepower hoist motor, with equal lifts, the No. 4 S. A. magnet has the advantage of 2000 pounds in total load to be lifted or 20 per cent. of the total hoisting capacity of the crane. This will mean a saving in current consumption of 20 amperes on the part of the hoist motor, and by virtue of this lower current consumption and lighter load the hoisting speed will be higher and the amount of material handled in a given time will be materially increased. Proportionable increases in efficiency are also shown by the No's. 5 and 5 type S. A. magnets.

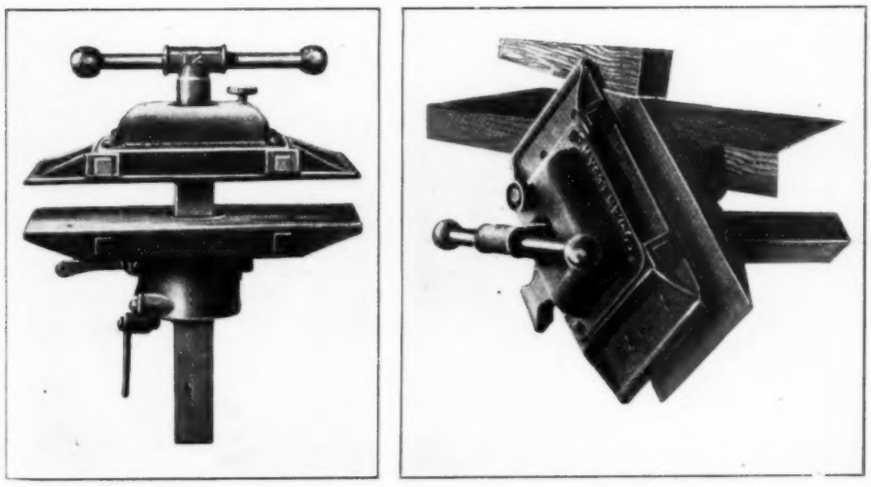
In Fig. 2 will be seen the magnet at work lifting ingot butts and plate scrap. Ingots have been lifted with this new type of magnet, when they were at a red heat without injuring the magnet.

The magnets are manufactured by the Electric Controller and Manufacturing Company, of Cleveland, Ohio.

Woodworking Vises

The G. M. Yost Manufacturing Company, Meadville, Penn., has improved its woodworkers' vise, as shown in the illustrations. They can be swung to any angle, as shown, so that the corners can be used to hold a small piece or to get up inside a piece of work. There are also two fingers on each jaw, which can be thrown out to grip work at different points, such as on a curve of almost any size.

As shown in the first view, the vise is attached below the bench so that the jaws come level when it is swung with the long jaws horizontal. The levers for clamping against rotation and for the small fingers or auxiliary jaws are shown in the illustration at the right.

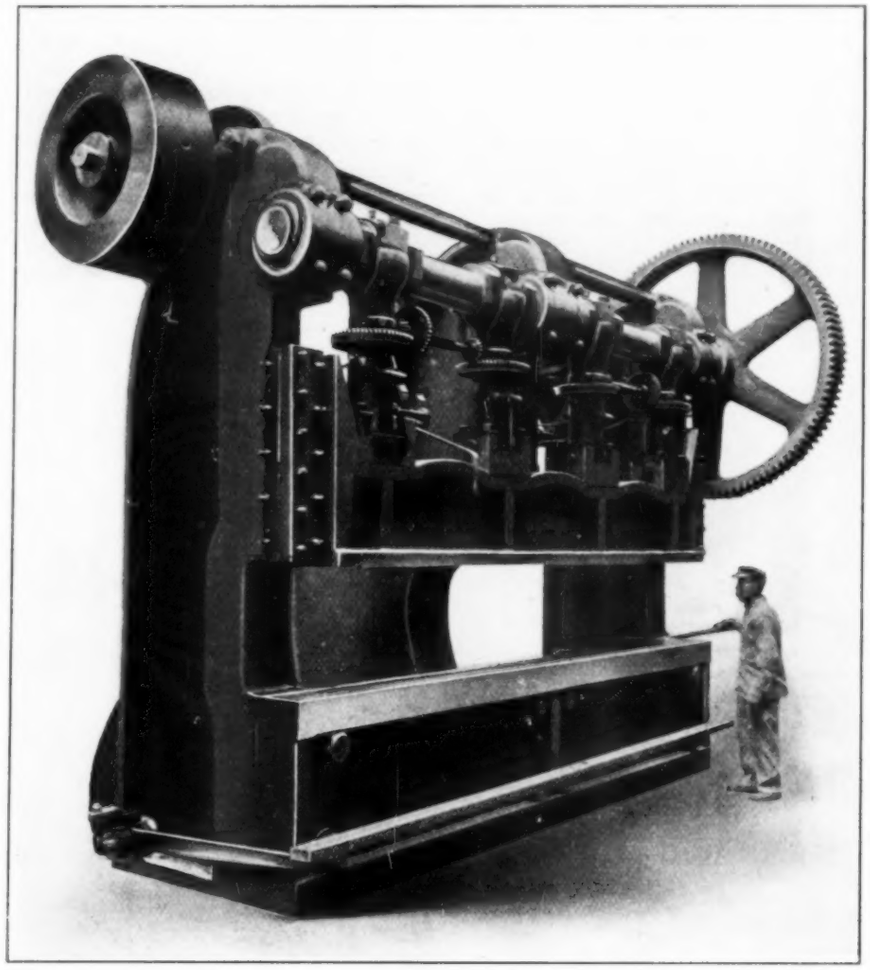


IMPROVEMENTS IN THE YOST VISE

A Large Quadruple Crank Press

The E. W. Bliss Co., No. 1 Adams street, Brooklyn, N. Y., has recently designed and built the large double double-crank press shown herewith. The press is an unusually large machine of the well known double-crank type being in reality a double double-crank press. The machine is especially adapted for the operation of very long and narrow dies, for punching, forming, piercing, bending, and similar operations which require great pressure. The machine which is double geared, is driven by a friction clutch located on the driving shaft; this clutch is engaged and disengaged by means of the treadle running along the entire front of the press; the treadle being connected by treadle levers with a treadle shaft located at the rear of the press to which is attached the counterweights and connections which operate directly upon the clutch. By this construction the press is under the control of the operator from any point in front of the press.

In the construction of large presses of the double-crank type an important consideration on account of alinement and weight is the adjustment of the slide. In



A LARGE QUADRUPLE CRANK PRESS

this press this is taken care of by a chain drive—the chains running from the shafts carrying the adjusting bevel pinions back to a small driving shaft which runs the entire width of the press. This shaft which derives its power by means of a belt from the main driving shaft, is fitted with two friction clutches. In order to raise or lower the slide it is only necessary for the operator to shift the lever located above the slide between the two cranks at the left-hand side of the press which engages the clutch which operates the chain drive. This in turn operates the four adjusting screws in unison, and insures quick and perfect alinement of the slide in relation to the bed. By shifting the lever to the right the slide is raised, and by shifting to the left it is lowered. The type of clutch used insures a very fine adjustment of the slide.

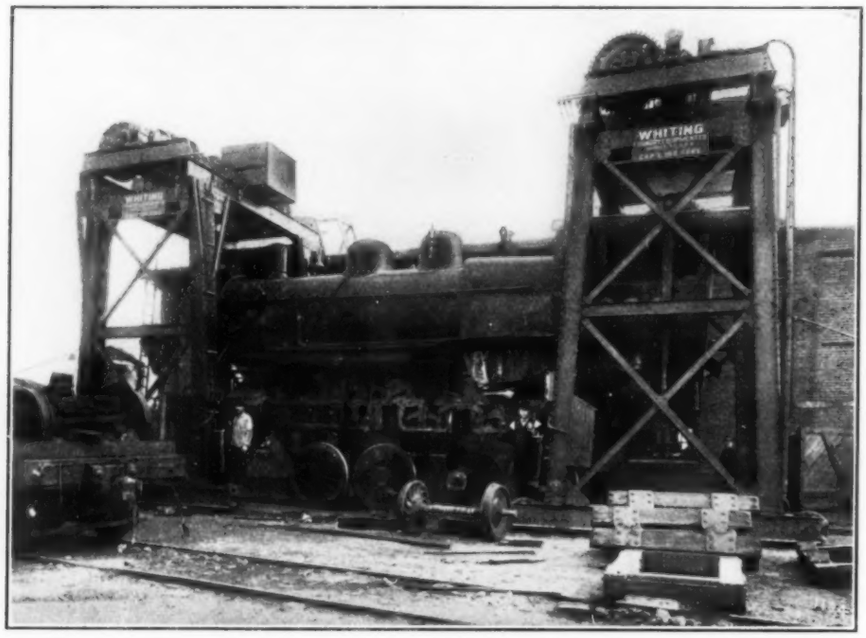
The bed which is removable is 154 inches long by 10 inches wide; the distance from the bed to the slide with stroke down and adjustment up, is 20 inches; the crank shaft is 8 inches diameter and has a 2½-inch stroke; the proportion of gearing is 18 to 1; all the gears are cut; the main gear is 75 inches in diameter by 9 inches face, and weighs 3700 pounds. The gearing is so arranged that it will not interfere with an operator standing at the back of the press. The flywheel is 36 inches in diameter with a 12-inch face, and weighs 2400 pounds. The total hight of the press is 140 inches, and the total weight over 72,000 pounds.

Large Gantry Cranes

The advantages of the Gantry type of crane are being recognized, and the illustration shows a recent installation on the Great Northern Railway at St. Paul, Minn.

These cranes are of the single-motor type with a capacity of 100 tons, and can be operated by hand when desired. The runway rails are 14½ feet apart, which gives a clearance of 13 feet between the legs, and the hight from the top of the rail to the under side of the girder is 20 feet, while the hook has a lift of 14½ feet.

As the hoisting speed is low a comparatively small motor gives all the power necessary and is equipped with an automatic electric brake operated by a solenoid in circuit with the hoisting motor, so arranged that it automatically comes into action if the current is cut off from the hoisting circuit. It is built by the Whiting Foundry Equipment Company, Harvey, Ill.



A LARGE GANTRY CRANE

A New Precision Lathe

This lathe has been developed by Frederick Pearce Company, 18 Rose street, New York City, to meet the demand of its own work in the manufacture of special instruments requiring very accurate work and at the same time necessitating heavy cuts when the size of the work and the lathe are considered. All four sides of the bed are finished square and parallel with each other, the top consisting of a flat and a V with a T-slot between, this being entirely for the tailstock or any fixture which may be made, although most of these will naturally be attached to the carriage on account of its vertical adjustment.

The carriage ways are on the front of the bed and extend the full length, so that the carriage may be run up beside the headstock as shown in Fig. 2. This is sometimes very convenient in facing the back of the work. The carriage has an extremely long bearing, the vertical knee occupying but half of this, and the remainder being planed square so as to be available for any fixture that may be desired. The slide rest is clamped to the elevating slide or knee by the thumb nut *A*, the bolt being extended to bring this in a convenient position. The knee is ele-

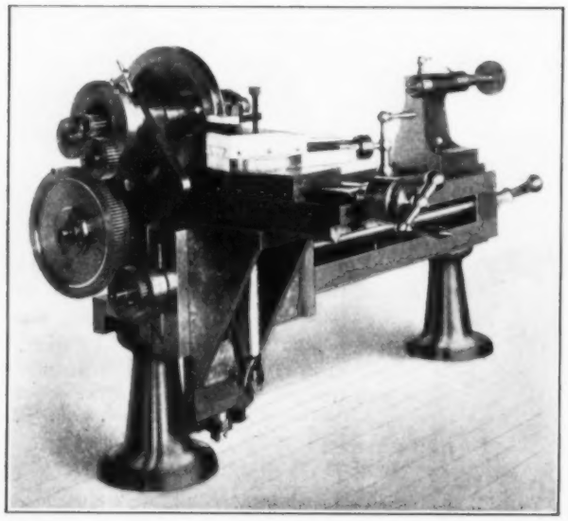


FIG. 1. PRECISION LATHE

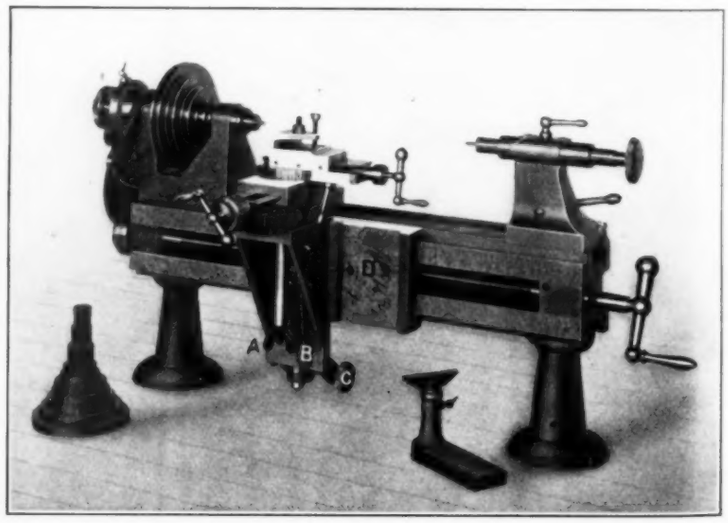


FIG. 2. DETAILS OF PRECISION LATHE

vated by the nurled handle *B* through the spiral gear *C*, and the slide is brought in any position by the lever *D*. This vertical movement is particularly convenient in locating the point of the tool exactly at the center and also when the slide rest is replaced by a milling or similar attachment, as the vertical movement of the knee does away with the necessity for this adjustment on any of the fixtures which may be made to be used with it.

The slide rest is very substantial and is held square with the lathe bed by a T fitting the knee. The slide rest is made with the compound slide, locked by the small handle shown beneath it, and both the cross and slide screws can be graduated to thousandths when desired. The tool block is particularly simple and efficient, consisting of a triangular plate held down by a central bolt and clamped down on the tool by the nurled screw shown. This allows the tool to be held at any angle or in any position, and also affords an easy method of attaching a grinding head. This consists of a very simple flat holder with no adjustment whatever, as the knee provides for all vertical movement, and the swiveling slide for all angular grinding.

The lead screw is 20 to the inch and is guaranteed to be correct within 0.0003 inch to the foot. The carriage is connected to it by a solid bronze nut which does not open. By having the gear on the spindle of the same number of teeth as the thread in the lead screw it is only necessary to put on a gear having as many teeth as the number of threads to be cut, so that all index plates and calculations are avoided. Provision is made for cutting metric threads and when desired a metric screw can be supplied. A graduated dial is provided at the left-hand end of the lead screw, so that any portion of a revolution may be determined for dividing lengthwise or for locating points on the work at exact distances apart.

The headstock has two cone bearings with provisions for taking up wear. The driving cone is held to the spindle by a slightly tapered nut compressing a sleeve in contact with it. The rim of the large pulley is divided into 120 index holes and provided with a suitable indexing pin. The small cross or T-wrench shown in Fig. 2 controls the tumbler gears, which are mounted on studs set in the split ring in the sleeve shown. This locks them positively in any desired position.

The tailstock has no screw for feeding the spindle, but is made a good sliding fit as in all drilling it can be pushed directly into the work much more rapidly and sensitively. For turning between centers it can be rigidly held in any desired position. It is provided with a draw-in chuck or collar of the same size as the live spindle, and the nurled wheel at the back is for this purpose. The bed is 20 inches long and will turn 10½ inches between centers, while the maximum swing is 6¾ inches. The slide rest has a travel of 14 inches, and the net weight of the lathe is 70 pounds.

Two Bench Lathe Details

The chasing bar of the bench lathe made by the Waltham Machine Company, Waltham, Mass., and recently illustrated, is an interesting detail not fully shown before. Those who are familiar with the Fox lathe will note the master screw or leader directly under the tool and see that all side strain and twisting are eliminated. The stop screw regulates the depth by coming in contact with the slide over the lathe bed. The tool block carries the circular tool in a round holder to allow it to be turned for any thread angle and also has two slots for the tool block.

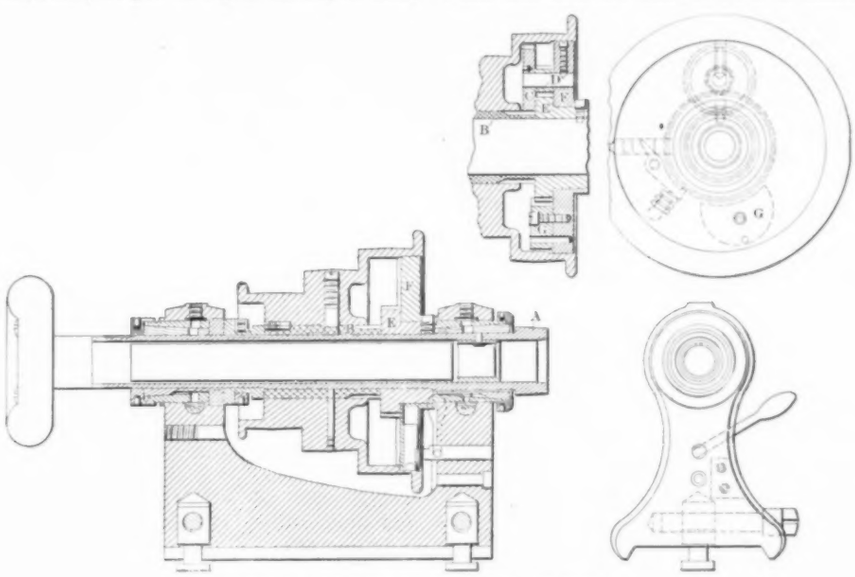


FIG. 2. DETAILS OF GEARED HEADSTOCK

The follower or nut is made of hardened steel and has three faces to fit three different pitches of master screws. The nut can be readily turned to bring either face into mesh with the master. The master of cast iron and the hardened-steel follower make a durable combination.

Back Geared Bench Lathes

There are times when a slower speed and more power is desirable even on a bench lathe and to meet these requirements the internal geared head shown in Fig. 2 has been designed to interchange with their regular head.

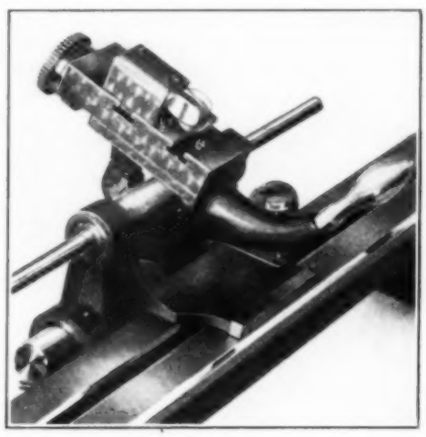


FIG. 1. A BENCH LATHE DETAIL

The general appearance is about the same as the regular head, the gears being inside the cone. The spindle *A* can be removed by taking out one set screw while the chuck tightening tube pulls out the back end. The bearings are of hardened steel, split and tapered on the outside to be drawn in for adjustment. End play is taken by hardened rings against the inside ends of the bearing shells and the adjustment is by the threaded collar at the back end.

The bronze sleeve *B* has gear teeth on the end which mesh in the gear *C*. This is fast to pinion *D* which in turn is in mesh with *E*, fast on the spindle. These are designed to give a 4 to 1 reduction so that six speeds are available at all times. The details of locking the spindle and core together are shown in the upper view, and *G* is the counterweight to insure a balanced cone.

Starting Polyphase Induction Motors

To meet the demand for an easy method for starting polyphase motors, the General Electric Company has made a device for automatically starting induction motors of both the slip-ring and squirrel-cage type for sizes over 5 horsepower and for voltages from 110 to 2080. These are so arranged that the proper sequence of movements must be given and they avoid all possibility of throwing the wrong switch or of damaging the motor or apparatus.

Heavy Work of a Plain Milling Machine

The illustrations show a Newton plain milling machine and cutter undergoing a test recently at the Newton Machine Tool Works, Philadelphia, the machine being a No. 4 horizontal, and, as can be seen, is simply fastened to two floor parallels instead of being on an adequate foundation.

The milling cutter is of the Tabor type, 8¼ inches in diameter by 20 inches long, and is driven by a broad-faced key. The

FIG. 2. TABOR CUTTER IN HEAVY CUT

piece being machined is 11½ inches wide, the cut ¼ inch deep, and the table travel 11½ inches per minute.

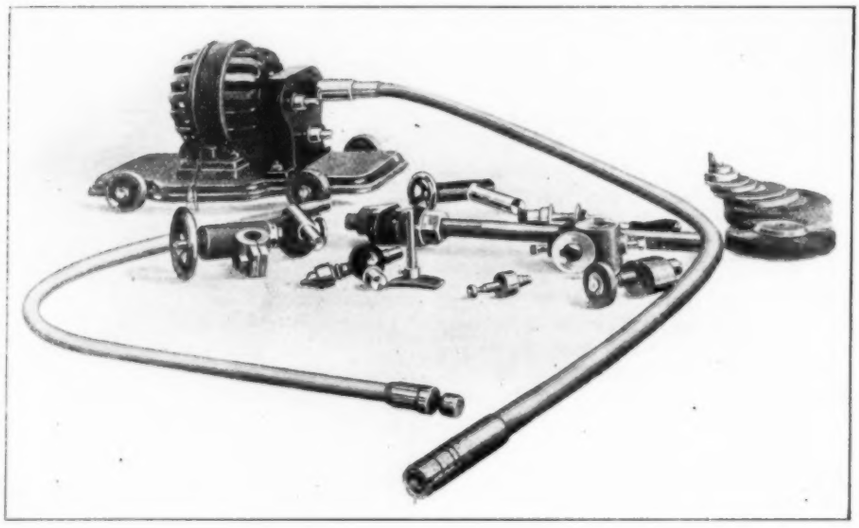
The milling machine has the usual features of the Newton build, the spindle being 5⅞ inches in diameter in the main bearing and having 6 inches of side adjustment. It can handle cutters up to 13½ inches in diameter, as the spindle is driven through a steep-pitch-bronze worm wheel and hardened-steel worm, connected by intermediate gearing to a 35 horsepower motor. The table is 30 inches wide and can mill a cut 72 inches long.

Figured out according to the power consumed, 1 cubic inch of metal was removed per horsepower per minute, but considerably better results have been obtained with a similar machine on a proper foundation.

A Portable Grinding and Polishing Outfit

The value of portable tools is becoming more recognized in every department of mechanical work and many uses for the outfit will be found in many shops.

The motor is a one-horsepower Westinghouse alternating current on a truck, and the equipment consists of a breast drill, portable drill press, emery wheels and polisher with all necessary clamps and braces. They are driven by a flexible shaft and a multiplier is provided for high-speed work. This outfit was recently furnished the Government by the Coates Clipper Manufacturing Company, Worcester, Mass.



PORTABLE GRINDING AND POLISHING OUTFIT

The Use of the Chemist in the Foundry

By William Miller Booth*

Five years ago it took courage to approach the ordinary foreman regarding analysis of his materials. The advance in this particular has been so great that few foundries now attempt to make gray-iron castings without some chemical assistance regarding the materials used. In the meantime the chemists have improved and simplified their methods so that a very good idea of the yard stock, fuel and finished casting may be obtained at an expense of $25 or $30. How to obtain accurate analyses and to use these systematically is one of the main problems of the foundry.

Iron cannot be sampled by fracture with any degree of certainty regarding its composition. Some may consider this debatable, although he is an excellent foundry foreman who can make even a close guess and therefore the chemist has become a necessity. If the foundry is not large enough to support its own chemical laboratory, samples can be collected by one who will give the subject his best attention. When the pigs to be analyzed have been collected, scratch, brush the central surface of the pig thoroughly; place it on the drill press on the flat side and drill a ¾-inch hole about ½ inch deep and discard these drillings. Then drill 1½ inches further and ladle the

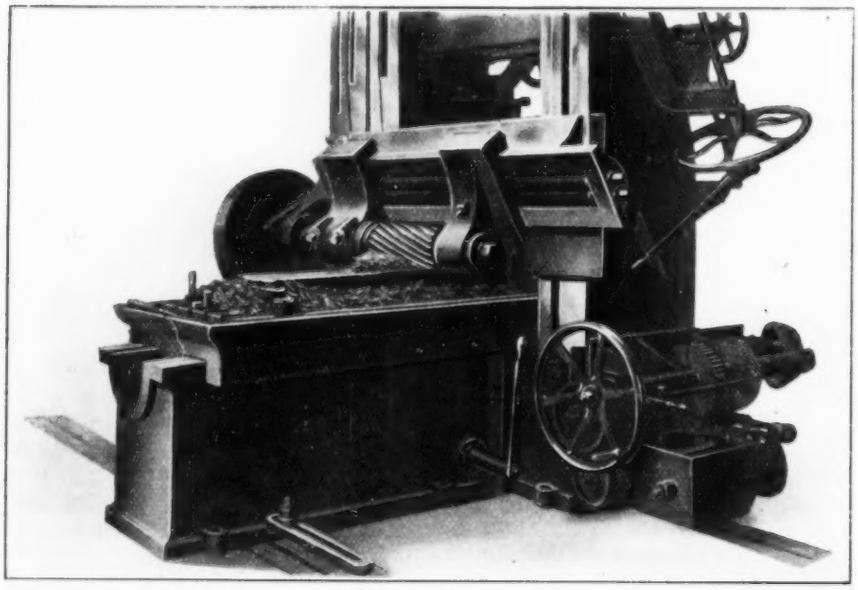


FIG. 1. HEAVY PLAIN MILLING MACHINE

*Chemical engineer, member American Institute of Chemical Engineers, Syracuse, N. Y.

drillings into a previously numbered ticket, being very particular to prevent the introduction of any sand or oil from previous work with the drill. Take a second sample from the next pig, about ⅓ of the way from the end and drill a similar hole in the side of this. Place the drillings in a second ticket similarly labeled. Take the third sample well toward the end of the third pig and transfer a suitable quantity to the third ticket. Repeat the process for as many samples of iron as your stock includes, with three envelops for each sample. Be sure that your several brands are in separate parts of the yard plainly labeled, A, B; 1, 2; or any other numbers known to the foreman.

Making up Samples for Chemist

Melt a charge of average scrap and take borings from the first, middle and last castings of the charge, and place these in three labeled tickets. Go to the coke pile and chip off a piece the size of a pea from twenty-five pieces of large, medium, and small coke. Thoroughly mix the three samples from each kind of iron on a clean, white paper quartering them at least three times. Return about one ounce to each of two of the tickets and date the same. Throw the third away with the rest of the iron before mixing the second sample; and repeat this for all the samples of pig and scrap. You need about one ounce in each ticket, as a single gravimetric analysis requires a full half ounce of drillings, and it is often necessary for the chemist to duplicate at least a part of the analysis. As a sample of pig iron may vary 1 per cent. in silicon from one end to the other or from one end to the middle, the importance of the preceding may readily be seen. Mix the sample of coke also, taking two samples of about one ounce each, discarding the remainder. At the office register the number and kind of samples, with the date. Seal carefully so that transportation will not spill the iron. Keep one sample of each on file in the office and send the duplicate samples to the chemist.

The usual elements called for are silicon, sulphur, phosphorus and manganese, their importance being according to the position in which they are named. A chemist, who makes up mixtures, requires also graphitic and combined carbon, as much may be learned from their ratio as well as from their total percentage. Insist upon gravimetric sulphur, manganese and graphitic carbon.

How to use the analyses that have been obtained, systematically is best shown by the following tables. Upon the samples submitted we have assumed the following results, the sample numbers having been arbitrarily assigned.

	Si. %	S. %	P. %	Mn. %	G.C. %	C.C. %
No. 1	1.45	0.015	0.30	0.40	3.00	0.30
No. 2	2.80	0.030	0.40	0.45	3.10	0.40
No. 3	3.00	0.050	0.60	0.80	3.20	0.40
Casting	2.01	0.052	0.50	0.36	3.12	0.37
Scrap	2.80	0.10	0.70	0.30	3.20	0.40

Coke.

Moisture	1.00%
Volatile, Hyd	2.00 "
Fixed carbon	87.00 "
Ash	10.00 "
Total	100.00 "
Sulphur	0.80 "

These irons contain the following number of pounds of metals and metalloids per ton:

	Iron Approx. by Difference.	Si.	S.	P.	Mn.	G.C.	C.C.
No. 1	1890	29	0.30	6	8	60	6
No. 2	1856.4	56	0.60	8	9	62	8
No. 3	1839	60	1.00	12	16	64	8
Casting	1871	40.2	1.04	10	7.2	62.4	7.4
Scrap	1870	56	0.20	14	6	64	8

The iron by difference is approximate as cast iron contains many ingredients not reported or necessary to consider excepting in grave cases. The number of pounds is given to show that a ton of iron is not by any means all iron.

Now, in reference to the use of the analyses returned: You wish to cast a gas-engine cylinder of about the following composition:

Silicon	2.00%
Sulphur	0.05 "
Phosphorus	0.40 "
Manganese	0.40 "
Graphitic carbon	3.12 "
Combined carbon	0.40 "

We will suppose that you need two tons, or 4000 pounds of iron. For this heat you propose to use 50 per cent. of No. 1, 25 per cent. of No. 2, 12.5 per cent. of No. 3 and 12.5 per cent. of scrap. Taking your chemist's report, figure the total of each element present in each grade of iron as follows:

4000 POUNDS OF IRON TAKEN.

Silicon.

No. 1, 2000 lb. x 0.0145 = 29 lb.
No. 2, 1000 lb. x 0.028 = 28 lb.
No. 3, 500 lb. x 0.03 = 15 lb.
Scrap, 500 lb. x 0.028 = 14 lb.

Total, 4000 lb.; total silicon, 86 lb.
Silicon, 86 lb. ÷ 4000 lb. = 2.15%
Less, 25%
1.90%

Sulphur.

No. 1, 2000 lb. x 0.00015 = 0.30 lb.
No. 2, 1000 lb. x 0.0003 = 0.30 lb.
No. 3, 500 lb. x 0.0005 = 0.25 lb.
Scrap, 500 lb. x 0.001 = 0.50 lb.

Total, 4000 lb.; total sulphur, 1.35 lb.
Sulphur, 1.35 lb. ÷ 4000 = 0.034%
Plus 100% = 0.068%

Phosphorus.

No. 1, 2000 lb. x 0.0030 = 6 lb.
No. 2, 1000 lb. x 0.004 = 4 lb.
No. 3, 500 lb. x 0.006 = 3 lb.
Scrap, 500 lb. x 0.007 = 3.5 lb.

Total, 4000 lb.; total phosphorus, 16.5 lb.
Phosphorus, 16.5 lb. ÷ 4000 = 0.41%

Manganese.

No. 1, 2000 lb. x 0.004 = 8.0 lb.
No. 2, 1000 lb. x 0.0045 = 4.5 lb.
No. 3, 500 lb. x 0.008 = 4.0 lb.
Scrap, 500 lb. x 0.003 = 1.5 lb.

Total, 4000 lb.; total manganese, 18.0 lb.
Manganese, 18 lb. ÷ 4000 = 0.45%
Less 25% 0.11%
0.34%

Graphitic Carbon

No. 1, 2000 lb. x 0.03 = 60 lb.
No. 2, 1000 lb. x 0.031 = 31 lb.
No. 3, 500 lb. x 0.032 = 16 lb.
Scrap, 500 lb. x 0.032 = 16 lb.

Total, 4000 lb.; graph. carbon, 123 lb.
Carbon, 123 lb. ÷ 4000 = 3.07%

Combined Carbon

No. 1, 2000 lb. x 0.0030 = 6 lb.
No. 2, 1000 lb. x 0.004 = 4 lb.
No. 3, 500 lb. x 0.004 = 2 lb.
Scrap, 500 lb. x 0.004 = 2 lb.

Total, 4000 lb.; comb. carbon, 14 lb.
Carbon, 14 lb. ÷ 4000 = 0.35%

Analysis of Casting; Approximately

Si	1.90%
S	0.068%
P	0.41%
Mn	0.34%
G.C.	3.07%
C.C.	0.35%

From your silicon in the heat you will lose 0.25 per cent. approximately, which leaves 1.90 per cent. silicon. You will undoubtedly double your sulphur even with excellent coke, making this 0.068 per cent., your phosphorus will be added to slightly from the phosphorus in the coke, but for practical purposes this remains about the same. Undoubtedly 25 per cent. of your manganese will oxidize; this deducted from 0.45 gives you 0.34 per cent. manganese. The graphitic and combined carbons take care of themselves, and every good foundryman knows how to handle the latter.

It will be noted that the percentage reports have to be reduced to a decimal before multiplying by the number of pounds taken; thus 0.05 per cent. is 5/100ths of 1/100th part or 0.0005ths of the whole weight taken. With a little practice any brand of casting may be approximated provided you have the necessary stock to make this flexible. You need a few thousand pounds each of three special irons.

(4) A high silicon iron which will analyze from 7 to 10 per cent. silicon.

(5) A high phosphorus iron analyzing 2 per cent. phosphorus.

(6) A high manganese iron analyzing from 7 to 20 per cent. manganese. This last iron will contain practically no sulphur.

From the analyses reported it is possible for any man, versed in ordinary arithmetic, to figure out different combinations that will be needed for his castings. High silicon for a soft casting, high phosphorus for an easy flowing casting; high manganese for a tough casting; high graphitic carbon for a soft casting and high combined carbon for a hard one, and all the different combinations so well explained by Thomas West in his work on this subject.

Coke

Having concluded the subject of mixtures a few words about the coke will not be out of place. If coke is spotted and contains oxide of iron from burned pyrites, dirty iron flowing with difficulty will probably result. You need a hard coke to hold your charge up, preferably under 12 per cent. ash and with sulphur not above 1 per cent. for coarse work and not above 0.80 per cent. for fine work. I have known foundrymen to worry nearly a week over castings that were nearly as hard as glass, insistent upon the infallibility of their methods. At the end of that time the

chemist found that they were using coke containing 2 per cent. sulphur. How much this had cost the foundry I cannot judge, but the expense was considerable. If you have hard castings, look first to your coke, and if necessary get a telegraph analysis on this. If it proves equal to the specification, and you still have difficulty from hard castings, it may be necessary to send samples from your entire yard stock, although the probabilities are that you are using some very high sulphur scrap. I have known this to run as high as 0.20 per cent. in heavy machine scrap. For some purposes sulphur is needed to close the pores of the iron. Ordinarily it is an element to be avoided and the foundryman who is so careless as to buy from irresponsible dealers, either iron or coke, is very liable to get a high sulphur product.

Summary

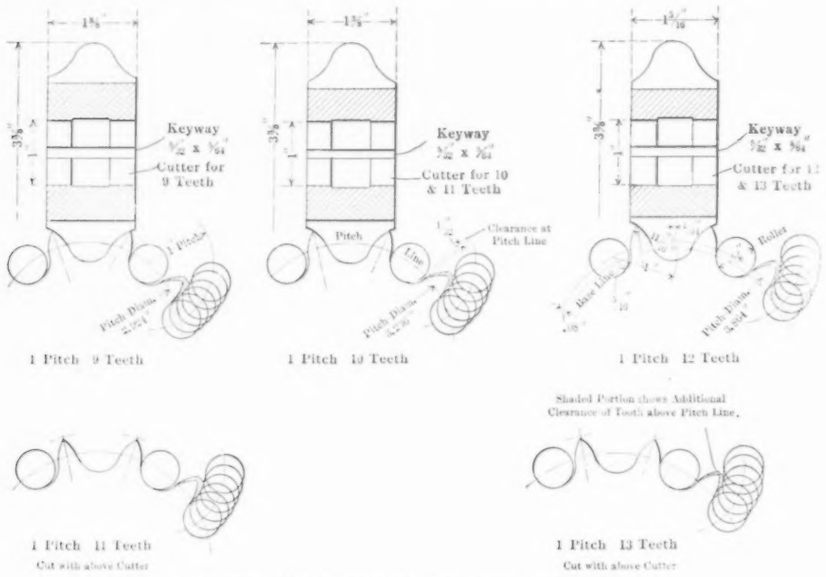
In concluding this article it may be said that if the foregoing suggestions are followed conscientiously a chemist can be made of great value to the foundry, and castings can be made for particular firms much more easily than by the old methods. It is absolutely essential in a modern foundry that the iron and fuel should be weighed. After having made up a formula and having obtained a good test bar, this may be analyzed and made a standard for certain castings. Keep a complete record of your analyses, each element under its proper heading with as much history of your successes or failures as may be valuable for future reference. Opposite the chemical test place the test-bar results, as both are necessary today in a well regulated foundry, doing good work. Do not imagine that a chemical analysis of cast iron compares with the prescription of a druggist. They are not comparable. To make a complete and accurate analysis of iron requires large experience. If this subject is properly handled chemistry in the foundry is a good investment.

Milling Cutters for Sprocket Wheels

Editorial Correspondence

We think little about the troubles of the other fellow, as a rule, until we are brought up against his problems, and then we begin to realize that others have troubles, too.

Take the apparently simple case of a cutter for milling the teeth in a sprocket for a chain drive, and we find the cutter-maker up against quite a difficulty. To begin with, the same cutter must be used for cutting both the driver and driven sprocket when, to be correct, the pitch of the driver should be larger than the pitch of the chain, while the pitch of the driven sprocket should be smaller than the pitch of the chain, as shown on page 749 of the first part of the present volume. This would necessitate two cutters, and is not to be considered for the average work.



CUTTERS AND SPROCKETS FOR WHITNEY CHAINS

But leaving this out of the question, the cuttermaker finds that chainmakers have decided differences of opinions as to the size of roller to use, and while this does not change the pitch of the wheel it does change the size of the cutter, as the space must be large or small, according to the roller.

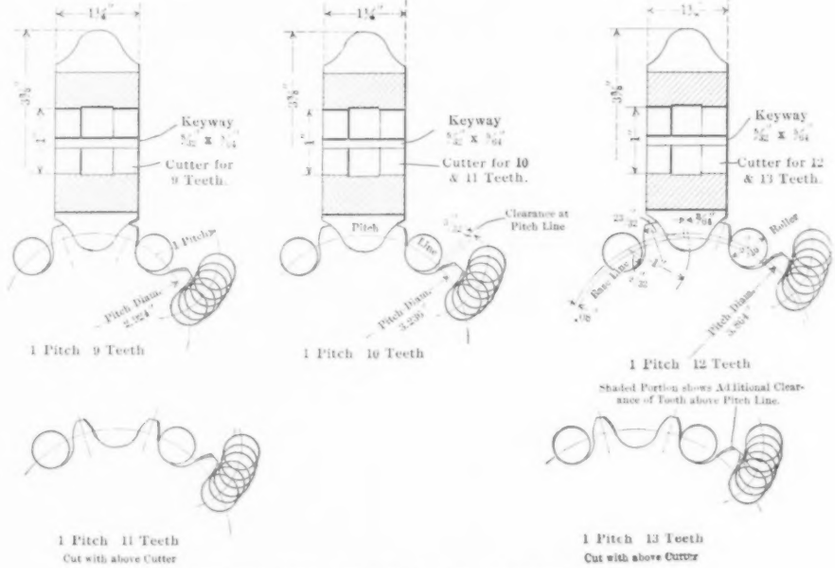
Then, too, the amount of clearance varies, which adds another difficulty to the question, and when we consult the catalogs of such well known chainmakers as the Diamond Chain Manufacturing Company and the Whitney Manufacturing Company, this difference is made very evident.

The Diamond chain advocates a 9/16-inch roller for a 1-inch pitch chain, and the clearance of 1/16 inch for a 12-tooth sprocket, and 3/32 inch for all above. The Whitney uses a 5/8-inch chain, and recommends a clearance of only 1/32 inch.

The makers of the Diamond chain recommend that sprockets be cut with cutters marked for the next lower number of teeth, that is, a 9-tooth cutter for a 10-tooth sprocket, and so on, especially for high-speed chains.

The makers of the Whitney chain say in their catalog:

"At this Date we Recommend the Following Plan: For Cutting 9 Tooth Sprockets use a Brown & Sharpe Cutter marked for 8 Teeth. For 10 Tooth sprockets use B. & S. Cutter marked for 9 Teeth. For 11 Tooth sprockets use B. & S. Cutter marked for 10 and 11 Teeth. For 11 Tooth sprockets try as an experiment B. & S. Cutter marked for 9 Teeth, as in certain cases it may prove better than the Cutter marked 10 and 11 Teeth. For 12 Tooth Sprockets use B. & S. Cutter marked 10 and 11 Teeth. For 13 Tooth sprockets use B. & S. Cutter marked 12 and 13 Teeth. For 13 Tooth sprockets use B. & S. Cutter marked 12



CUTTERS AND SPROCKETS FOR DIAMOND CHAINS

and 13 Teeth. For 13 Tooth sprockets try as experiment B. & S. Cutter marked 10 and 11 Teeth. For 14 and 15 Tooth Sprockets use B. & S. Cutter marked 12 and 13 Teeth. For 16, 17 and 18 Tooth sprockets use B. & S. Cutter marked 14 to 16 Teeth. For 16 Tooth sprockets try as experiment B. & S. Cutter marked 12 and 13 Teeth. For sprockets having 19 to 25 Teeth, inclusive, use B. & S. Cutter, marked 17 to 20 Teeth. For 19 and 20 Tooth sprockets try as experiment B. & S. Cutter marked 14 to 16 Teeth. For sprockets 26 Teeth or over, use B. & S. Cutter marked 21 Teeth and over. For sprockets 26 Teeth and over, try as experiment B. & S. Cutter marked 17 to 20 Teeth.

"In time it may be found that the above plan can be improved upon, but if customers will follow these suggestions cutting sprockets to the correct bottom diameter on machines with accurate indexes which will space the teeth uniformly, and if they will make the width of sprockets and shape of teeth on the sides in accordance with the instructions given on next page excellent results should be obtained. We also recommend removing the sharp corners of sprocket teeth with a file after cutting."

These various recommendations do not leave one with a very definite idea of what to do in the matter, except that all agree on the importance of having the bottom of the space of the correct diameter.

Mr. Boynton, mechanical engineer, of the Union Twist Drill Company, of Athol, Mass., has prepared some diagrams giving their practice in the matter. The tooth shape was laid out to have the link clear under the most severe conditions, that of swinging on the next pin, which very seldom occurs. The shaded portions show clearance and the different tooth shapes and thickness due to the two sizes of rollers used can be readily seen.

As a matter of fact, there is little, if any, need of the teeth extending far above the pitch line and on this account the upper end of the tooth has additional clearance, as shown. A stub tooth would answer very nicely in most cases.

Those who are just starting in to make and use sprocket wheels are liable to be confused as things are at present, and it would seem as though matters might be made clearer and easier for all hands if something definite could be decided on. Tests could easily be made that would show which clearance gave the least friction, or wore the longest, and it should not be hard to arrive at conclusions which would enable sprocket-wheel cutters to be marked with the number of teeth they should automatically cut instead of being one more or one less, or some other arbitrary combination.

Opinions as to the size of rollers might easily differ which would necessitate marking the cutters so as to designate the roller diameter as well as the pitch, but there seems no other good reason for not arriving at a standard cutter for each pitch.

F. H. C.

Apprenticeship in Fitchburg and Elsewhere

The Fitchburg, Mass., High School plan for its industrial class is particularly fortunate in being able to try the experiment in a city where practically every manufacturer is in hearty sympathy with it and also in the selection of an instructor who has a broad, common-sense view of the situation.. With almost every shop in town taking the boys into their employ the tendency or temptation to induce boys to leave the school or leave the other shop to work for them as is too often done in regular apprenticeship, is entirely absent.

In the Fitchburg class each boy, so far as possible, is allowed to choose the shop he will work in, each shop being assigned two boys for every vacancy, as only one is at work at a time, the other being in school during that period. Each boy is looked after by the instructor, and visited in the shop as often as possible. Some fail in their shop work, but more in their studies, this being to some extent due to their not taking this end of the education seriously, failing to realize its importance. It is far easier to see the necessity of learning to do actual work than to see why he should bother about such things as pulley speeds, gear ratios or leverage, but it will not be many years before he can see just where they are useful and what they mean to him.

Some have been dropped after a trial because they showed no aptitude for the machinist's trade, and it is realized that a good dry-goods clerk is of more use to the community than a poor machinist. Those who have failed in school and are dropped on that account are not discriminated against, as they are then free to spend all their time at their trade in any shop that has room for them.

The value of this "every other week" training, as in any apprenticeship, depends both on the boy and on the shop he is in. Assuming that the boy must do fairly well to avoid being dropped, his learning of the trade still depends on the amount of time that is devoted to training him and the extent to which the shop attempts to make him a profitable employee. It is very evident that when a boy is learning to do some new kind of work, he cannot turn out enough of it to be very profitable, if at all. This accounts for the tendency to keep a boy at a certain work after he has learned how to do it well, and is perhaps not to be wondered at.

In the Fitchburg case there seems to be complete harmony between the school and the manufacturers, and every effort is made to push the boys along as fast as possible instead of holding them back for profit, and, considered in the broad sense, this is probably the cheapest in the end, as the boy becomes an all-round producer that much sooner. Then, whether he stays in the same shop or not, providing he does not leave the city, the manufacturers have well trained young men in a shorter time than by the old method. Even with the half-time schooling, there should be a shortening of time over the method of exploiting a boy by keeping him at one job as long as possible without having him object too strenuously.

The possibilities of a shorter training for the making of machinists will be brought home to anyone who sees the class of work done by Professor Sweet's boys in Syracuse, where they are trained as rapidly as possible and learn to make commercial articles in a very short space of time, so as to be not only salable, but in demand by those who know them. This emphasizes the question as to whether it is not desirable to train a boy in the shortest possible time, and even though it be a constant expense during the training, rather than drag it along over a much longer period so as to get back part or all of the investment at the time.

If it were not for the question of the boy going to another shop as soon as he had finished his training, many would probably favor this plan although it must be conceded that there is a certain advantage to be had from a longer period, owing to the natural absorption of ideas that comes unconsciously from contact with mechanics and machinery.

This question is eliminated if all the manufacturers go into whatever educational plan is adopted, or if it is done by the town, all shops paying their proportionate share in the taxes. If it is confined to one trade, the shops in that line can combine or can each be charged with a portion of the extra expense for training their boys, assuming that the training is done in a special shop as in Professor Sweet's case.

Some manufacturers claim that it does not pay to have any boys in the shop; that the amount invested in tools for each man in the shop makes it inexpedient and often a positive loss, as an expensive tool, representing several thousand dollars may be tied up in instructing a boy how to set work or tools. For this reason some take no apprentices, relying on getting men elsewhere, or on helpers picking up enough to run certain machines. This is not necessarily because of lack of interest in the boy, but because they do not feel that it is best to do anything that is not economical in the shop.

Other shops, among them Bullard's, of Bridgeport, claim that apprentices do pay, that careful time records show a small profit while the boy is learning his trade, not the first six months, or even the first

year, perhaps, but taken as a whole, during his time of apprenticeship. But, whether it pays or not, apprentices must be trained somewhere and by someone in a greater or less degree according to the work to be done. If one shop does not and the other does, the one must train for the other to a greater or less extent. So that, taken as a city or a State, or any other way, it may be cheaper and better to train boys in special schools or shops, either with or without books at the same time, although the plan being used in Fitchburg appeals to the shop man even more strongly than the special school or shop. This gives a boy actual shop training, which has many advantages, and also has the advantage of being easily adopted, as it requires very little from the local school board, simply special instructors along this line. This, however, relieves the regular teachers of a similar amount of work and it might not be an additional expense at all. It certainly looks like the line of least resistance.

Business Items

Peter A. Frasse & Co., New York, has opened a branch office and warehouse at 50 and 52 Exchange street, Buffalo, N. Y., where a full line of steel tubing, tool steel and other steel specialties will be carried.

The Royersford Foundry and Machine Company has appointed Edgar A. Wilhelmi of 125 East Twenty-third street, as agent in New York. He will also look after the export business of the company.

A complete electric power plant, including motors, transformers and switchboards, has been shipped by the Crocker-Wheeler Company, Ampere, N. J., to the Windham Manufacturing Company, Willimantic, Conn.

The United States Army has placed in commission the second of the two gigantic hydraulic dredges required for service in the Gulf of Mexico. Oil is used as the only fuel, the entire equipment being furnished by Tate, Jones & Co., Pittsburg.

The Lunkenheimer Company, Cincinnati, Ohio, has received an order from the Isthmian Canal Commission for 7000 "Renewo" renewable seat and disk regrinding valves, ranging in sizes from ¼ to 3 inches, inclusive.

The Wabash Railroad Company has just awarded to the Wagner Electric Manufacturing Company, of St. Louis, a contract for supplying its Fort Wayne, Indiana, locomotive repair shops throughout with Wagner polyphase motors.

The Wagner Electric Manufacturing Company announces the appointment of Frank N. Jewett, as general sales manager, with headquarters at the main office and factory in St. Louis. Mr. Jewett has been district manager of the Wagner Company at Chicago for the past three years.

Schuchardt & Schutte, the well-known machinery house of Berlin, Vienna, Stockholm, St. Petersburg, Copenhagen, Budapest, London, New York and Shanghai, announce that they have opened a branch under their own name for the sale of machine tools, wood working machines and small tools at No. 14 Akashicho Tsukiji, Tokio, Japan. This branch is under the management of James G. Brown, who has spent several years in the Far East in the interests of this firm.

The Cleveland Crane and Engineering Company, Wickliffe, Ohio, is finding considerable improvement in business lately, shipments for some time past having been steadily improving. Among its recent shipments are two 10-ton 3-motor, 40′-span alternating current cranes to the Puget Sound Navy Yard, one 10-ton 3-motor, 40′-span crane to the New Orleans Navy Yard; one 75′ 15-ton crane to Dallas, Texas; two 20-ton 3-motor cranes to the Isthmian Canal Commission for the Panama power houses; one 15-ton 3-motor 50′-span crane to the Erie Foundry Company, Erie, Penn.

The New Process Raw Hide Company, Syracuse, N. Y., manufacturers of New Process pinions and cut gears of all kinds, is about to construct a considerable addition to its present plant. The company has been operating its plant nights for two months and has at the present time the largest payroll in its history and business is coming in faster than it can be gotten out advantageously in the present plant. The new addition, for which contracts have already been let and which is now under construction, will consist of two stories and a basement, 60x80 feet. The cost of the new building complete will be from $25,000 to $30,000 and the company has machinery on order for delivery during the next two months approximating $12,000, consisting principally of automatic turret lathes, bevel gear planers and grinding machines. An additional hardening furnace for treating automobile transmission gears and drive gears will also be installed.

The receivers appointed on October 23, 1907, for the Westinghouse Electric and Manufacturing Company were discharged on December 5. During the time they were in charge they not only succeeded in paying off the interest on bonds as it fell due from time to time, but also kept the factories of the company in operation during the entire time, doing a good business at a net profit of over $1,000,000. The board of directors, which consists of the following: George Westinghouse, E. M. Herr, James S. Kuhn, Joseph W. Marsh, William McConway, J. L. Callery, Richard Delafield, Albert H. Wiggin, Charles S. Brooker, A. G. Becker, Charles A. Moore, Edwin F. Atkins, Neal Rantoul, E. C. Converse, Anthony N. Brady and George Verity, held a meeting in New York, Monday, December 7, and organized as follows: President, George Westinghouse; temporary chairman of executive committee, E. C. Converse; first vice president, E. M. Herr; second vice president, L. A. Osborne; acting vice presidents, G. W. Hebard and W. M. McFarland; secretary, Charles A. Terry; treasurer, T. W. Siemon; assistant treasurers, E. St. John and H. F. Baetz; auditor, J. C. Bennett.

Trade Catalogs

The Chandler Company, Springfield, Mass. Pamphlets showing name plates, letters, figures, steel stamps, etc.

Bury Compressor Company, Erie, Penn. Catalog No. 40, describing air compressors. Illustrated, 28 pages, 6x9 inches, paper.

American Steam Gauge and Valve Manufacturing Company, Boston, Mass. Catalog of valves. Illustrated, 90 pages, 6x9 inches, paper.

Snell Manufacturing Company, Fiskdale, Mass. Catalog of augers and bits, boring machines and carpenters' tools. Illustrated, 48 pages, 8x10½ inches, paper.

Harris Smokeless Furnace Company, Inc., Nashville, Tenn. Catalog, describing Harris smokeless furnace. Illustrated, 48 pages, 7½x10 inches, paper.

Western Electric Company, 463 West street, New York. Booklet showing induction motors applied to machine tools. 12 pages, 3½x6 inches.

The Cleveland Twist Drill Company, Cleveland, Ohio. Catalog No. 36, describing Peerless high speed reamers. Illustrated, 24 pages, 6x9 inches, paper.

Geo. V. Cresson Company, Philadelphia, Penn. Catalog A, describing shafting, bearings, pulleys, gearing. Illustrated, 38 pages, 4½x7½ inches, paper.

American Boiler Economy Company, North American Building, Philadelphia, Penn. Catalog describing Copes boiler feed regulator and pump governor. Illustrated, 32 pages, 6x9 inches, paper.

Wheeler Condenser and Engineering Company, Carteret, N. J. Bulletin No. 103, describing Wheeler-Edwards patent air pump. Illustrated, 32 pages, 8x10½ inches.

Landis Machine Company, Inc., Waynesboro, Penn. Catalog of bolt threading, pipe and nipple threading, nut tapping and special threading machines. Illustrated, 40 pages, 6x9 inches, paper.

Business Opportunities

The Ohio Steel Foundry Company, Lima, Ohio, will enlarge plant, it is said.

The Milwaukee (Wis.) Bridge Company will erect a $30,000 addition to plant.

The M. L. Oberdorfer Brass Company, Syracuse, N. Y., will erect a new brass foundry.

The National Malleable Casting Company, Cleveland, Ohio, is erecting an addition.

The Champion Shoe Machinery Company, St. Louis, Mo., will erect a new plant.

The Tropenas Steel Works, New Castle, Penn., will build an addition to its plant.

Clinch Valley Lumber Company, Pikeville, Ky., will rebuild its plant recently burned.

The Green Bay (Wis.) Cornice and Corrugating Company has purchased site for a new plant.

The Harris Cooperage Company, Lebanon, Ala., will establish cooperage at Fort Payne, Ala.

The American Malleable Company, Lancaster, N. Y., will double the capacity of its plant.

The Hewitt Manufacturing Company, St. Louis, Mo., brass founders, will erect a new plant.

The Screw Cutting Company of America, Philadelphia, Penn., will erect a new two-story factory.

The Fred Rueping Leather Company, Fond du Lac, Wis., will erect a tannery in Milwaukee.

A new plant will be erected for Becker, Smith & Page, Inc., Philadelphia, Penn., paper manufacturers.

The wooden novelty plant of P. J. Donnelly, Pittsfield, Mass., was destroyed by fire. Loss about $25,000.

The plant of the Nebraska-Moline Plow Company, at Omaha, Neb., recently burned, will be rebuilt.

W. H. Starr Lumber Company, Judsonia, Ark., will establish a saw and planing mill at Letona, Ark.

Fitzgerald & Company, Bessemer, Ala., will establish a machine shop and foundry for making castings.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m. January 4 for steel, iron, copper tubing, bolts, rivets, nuts, twist drills, iron washers, lathe dogs, taps, reamers, dies, tinners' shears, oilers, pulleys, leather, belt lacing, etc., as per Circular No. 484.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open

the following bids: December 29—1 turret lathe (schedule 683), generator set (schedule 692). January 5—3 engine lathes (schedule 687), rotary splitting shear (schedule 688). January 12—Pipe expanding and flanging machine (schedule 679), generator set (schedule 685).

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machinery built to order. Up-to-date plant. Write Brunswick Refrigerating Co., New Brunswick, N. J.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Machines designed; automatic, special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Will accept good patent right, in part payment for real estate. Give particulars and price. Box 121, Cincinnati, Ohio.

Patent agent in Japan. Patent, trademark. Most reliable experienced engineer. Y. Tsurumi, 144 Bentencho, Ushigome, Tokio.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Wanted in Manhattan, Brooklyn, or Jersey City, machine shop to build some medium sized machines, also space 20 ft. square to demonstrate. Box 748, AMER. MACHINIST.

Wanted—Articles to manufacture by contract or will buy patent, tools and fixtures outright, by a manufacturer having a large and well equipped plant and capital. Address Box 564, Erie, Penn.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Master Mechanic Wanted — A man with large manufacturing experience of both large and small work; one with drafting and machine shop training and who is a good executive. In answering, state fully your experience in detail, so as to afford one of the best means of passing upon your qualifications. Box 721, AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Practical uptodate tool man, 31, designer, draftsman, wants position as foreman. Capable of handling men: 14 years' experience, 2 as foreman. Box 751, AMER. MACHINIST.

ILLINOIS

General superintendent wants position January 1, 1909. Capable of managing factory for best results, factory organizing, increase production and cost system. Best of references as to ability and past record. Box 744, AMERICAN MACHINIST.

INDIANA

General superintendent and works manager will be at liberty Dec. 1. Ten years with high-class concerns in Middle West; experienced in foundry, machine, sheet metal, forge and woodworking lines, with up-to-date ideas of shop organization and practice on economical production. Address "Superintendent," 1105 No. Alabama Street, Indianapolis, Ind.

MASSACHUSETTS

I wish to correspond with any company desiring the services of a progressive and up-to-date manufacturing superintendent. Box 701, AMERICAN MACHINIST.

Superintendent or general foreman, 25 years' practical experience. Prefer large or medium work. Capable, energetic and familiar with use of high speed steel. Thoroughly versed in engine work. Box 726, AMERICAN MACH.

MICHIGAN

Designer on machine tools and on special machinery, tools and fixtures. Experienced and capable. Box 753, AMER. MACHINIST.

NEW JERSEY

Mechanical engineer, designer and machinist, inventive ability; have held positions as assistant manager, chief draftsman and foreman; automatic machinery a specialty. Box 750, AMERICAN MACHINIST.

NEW YORK

Position setting up Brown & Sharpe, Acme and Cleveland automatics. Box 739, AM. MACH.

As superintendent by first class mechanic after first of January. Best of references. Box 710, AMERICAN MACHINIST.

First class mechanical draftsman and designer, technical graduate, 7 years' experience, wants position. Box 743, AMERICAN MACHINIST.

Desire to confer with concern needing experienced man, with executive, business and mechanical ability to eventually become a partner. Address Box 737, AMERICAN MACHINIST.

Designer of small interchangeable machinery, electrical recording apparatus, spark coils; wishes position as assistant superintendent or chief designer. Box 749, AM. M.

An educated and well trained business man is open for a position as office or works manager or of similar capacity; age (34), American, technical education, accountant; 3 years' on staff of ablest New York systematizer and business economist, making numerous inspections and investigations. 12 years' practical experience in successfully handling office details and in all mechanical and textile manufacturing departments. A natural executive, versatile, above the average in personal appearance and thoroughly familiar with modern business practice, conservative management of office, manufacturing costs, correspondence, sales, credits and collections. Ready to tackle any manufacturing business and build it up to a profit-paying basis. Best references; salary commensurate with ability; ideal personality for confidential investigating secretary to the president of any large concern. Box 42, 225 West End avenue, New York City.

PENNSYLVANIA

Position wanted by a tool department foreman; a high-class man. Box 746, AM. M.

Mechanical, structural draftsman, 27, technical graduate, five years' practical experience, wants work. Box 738, AMER. MACH.

All-round machinist, tool and diemaker with inventing ability wants position; A-1 references. Address B. Withlock, 936 North Fifth St., Philadelphia, Pa.

Designer, skilled in originating and developing special and automatic machinery and overlooking construction; expert in printing and numbering machinery. Box 752, AMERICAN MACHINIST.

VIRGINIA

Wanted by a practical and theoretical machinist and draftsman with technical and executive ability, position offering an opportunity for advancement; references furnished; age 25. Box 747, AMER. MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Wanted—Thoroughly reliable young married man, about 30 years of age, who has had experience in cost accounting and factory time department. Long experience not necessary, but must be thoroughly accurate. Apply Box 735, AMERICAN MACHINIST.

Wanted—Chief draftsman of proved designing and executive ability, as well as energy and brains, to distribute and accurately supervise work, check up drawings and systematize records and methods in designing department of Chicago factory employing from 300 to 500 men in the manufacture of special automatic machinery. Excellent opportunities will be offered to high grade man. State fully qualifications and previous experience along these lines, with references. Box 733, AM. MA.

INDIANA

Wanted—Two inspectors, two grinders, six lathe men, two toolmakers, one foreman, four machinists, all for work on gasolene motors. Good wages. Box 666, AMERICAN MACHINIST

KANSAS

Wanted—Blacksmith for foreman of college shop. Require an expert smith who has ability and patience to instruct students. Salary to start $900.00 for 11 months. Box 663, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—By large manufacturing company, draftsman for textile machinery. Should be capable of designing and overseeing details. State experience in detail and salary expected. Box 745, AMERICAN MACHINIST.

Wanted—A superintendent of unquestioned high character, capacity and ability to take charge of machine shop 200 men or less. Must qualify as an expert modern tool designer and maker. Must be experienced in producing good work, both large and small, at low labor cost. Must know how to handle men. The man who places salary and hours on duty secondary to the business interests of employers preferred. Box 709, AMERICAN MACHINIST.

MICHIGAN

Wanted—A number of operators on Jones & Lamson, Potter & Johnston and National Acme machines, both day and night work. Must be men of first-class experience. Cadillac Motor Car Company, Detroit, Michigan.

Wanted—One first class operator of Acme and Hartford automatic screw machines. A man that can set up and understands tooling. None other need apply. The Winkley Company, Detroit, Mich.

MISSOURI

A large electrical manufacturing company requires a capable, experienced foreman for its indicating instrument department; previous experience indispensable. Apply, giving experience and, salary expected. All communications confidential. Box 680, AM. MACH.

NEW YORK

Salesman with shop experience to sell small tool of recognized merit used in all machine shops. To receive attention, applicant must give age, experience and salary expected. "Mechanical," AMER. MACHINIST.

Wanted—A draftsman and designer, experienced in watch factory practice, designing and building watch and clock movements and tools for manufacturing same. Only man of experience wanted. "X. Z.," Box 741, AMERICAN MACHINIST.

Technical graduate, 28-30 years old, with shop experience in light fast running machinery. Must be good machinist. Man who has the foundation educationally and mechanic to develop into assistant superintendent. Near Philadelphia. "Rotary," care AMER. MACH.

OHIO

Wanted—Thorough, first-class works manager or superintendent for a large machine tool factory. Must have real executive ability and be capable of producing good work and lots of it, to the best advantage—a hustler. Young married man preferred. All correspondence treated strictly confidential. Address Box 720, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—First-class draftsman, must be familiar with machine tool shop practice. One capable of taking charge of drawing room preferred. State experience, age and wages expected. Give reference. Box 736, AMER. MACH.

Wanted—A first class mechanic—a pusher, qualified to handle men, systematize and get the goods through the factory expeditiously. To such a man there is open an exceptional chance for investment and the superintendency of an established and paying gas and gasolene engine factory in one of the best cities in the United States. Write at once. Address, Millard F. Harnish, Lancaster City, Pa.

Foreman painter wanted by a concern manufacturing high grade automobiles to take full charge of chassis and body work, a man who is capable of organizing the shop to turn out 25 to 30 cars per week. Only persons who have been connected with best automobile concerns, fully capable of handling this class of work, will be considered. Best of references required. State salary expected. Box 734, AMERICAN MACHINIST.

WISCONSIN

Wanted—First class mechanic, to take charge of tool check room of electrical manufacturing company in Middle West. Elderly man preferred. In applying state age, experience and wages wanted. Box 742, AMER. MACH.

We want, for one of the largest automobile factories in the Central West, one or two men to act as instructors in our repairing and manufacturing departments. This would include giving advice to less experienced men how to build and adjust the different parts, the reasons for doing things certain ways, etc. The inspector must have the ability, tact and patience to impart the information fully. We prefer men who have been for twenty years or more practical machinists. If you are the man

and want the position, state experience, wages, etc. Address, "Manufacturer," AMER. MACH.

FOREIGN

Wanted—Capable, energetic man as foreman in well organized factory manufacturing light machine guns. Must be able to turn out accurate, interchangeable, highest class work quickly and at low cost. None but highly qualified men need apply. One with American experience preferred. Liberal salary to right man. State age and experience. Box 740, AMERICAN MACHINIST.

For Sale

Garvin No. 3 hand-feed milling machine. I. F. Wales, Keene, N. H.

For Sale—One second-hand Wheeler planer 22x5 ft., $125. S. M. Langston, Camden, N. J.

For Sale. Patent No. 846,245 for a new and valuable lathe center grinder. Box 735, Muncy, Penn.

For Sale, absolutely new, a No. 2½ heading machine and a No. 2½ reheading machine, Waterbury-Farrel make, never used. Ohlen Company, Box 740, Columbus, Ohio.

For Sale—A solid brick, steel construction, factory building, with 7½ acres of land near Chicago. Now unoccupied. Size 110x541. Suitable for iron working business. Has engine, boilers, dynamos, etc. Most favorable price and terms will be given. Chicago Highlands Association, 1315 Wells Building, Milwaukee, Wis.

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Hart & Cooley Co	63
Heald Machine Co	91
Hendey Machine Co	55
Henry & Wright Mfg. Co	67
Hess-Bright Mfg. Co	83
Hill, Clarke & Co., Inc	103
Hill Publishing Co	62 and 98
Hisey-Wolf Machine Co	94
Hoefer Mfg. Co	66
Hoggson & Pettis Mfg. Co	80
Horsburgh & Scott Co	79
Horton & Son Co., E	80
Hoskins Co., The	85
Hunt Co., Robt. W	95
Hurlburt-Rogers Machine Co	76
Independent Pneumatic Tool Co	87
Industrial Oxygen Co	86
Ingersoll Milling Machine Co	65
Jacobs Mfg. Co	81
Jantz & Leist Elec. Co	93
Johnson Machine Co., Carlyle	101
Jones & Lamson Mach. Co.,	12, 13 and 40
Juengst & Son, George	64
Kearney & Trecker Co	26
Kelly Co., R. A	74
Kempsmith Mfg. Co	22
Knight Machinery Co., W. B	73
Lamson Consolidated S. S. Co	91
Landis Machine Co	17
Landis Tool Co	49
Lapointe Machine Tool Co	95
Lea Equipment Co	71
LeBlond Machine Tool Co., R. K.	55 and 4th cover
Leonard Mfg. Co	76
Lincoln-Williams Twist Drill Co.	59
Link Belt Co	66
Lodge & Shipley Machine Tool Co	4
Long & Alstatter Co	72
Lucas Machine Tool Co	105
Lumen Bearing Co	86
Lunkenheimer Co	64
Lyon Metallic Mfg. Co	101
Manning, Maxwell & Moore, Inc	88
Manufacturing Equipment & Engineering Co	86
Manville Bros. Co	76
Manville Machine Co., E. J	63
Maris Bros	88
Marshall & Huschart Mch. Co	102
Massachusetts Saw Works	75
McCabe, J. J	27 and 102
Merritt, Jos	40
Merritt & Co	77
Metal Hardening Solution Co	85
Millers Falls Co	72
Milton Mfg. Co	63
Mitts & Merrill	70
Modern Tool Co	82
Morrow Mfg. Co	81
Morse Chain Co	64
Morse Twist Drill & Mach. Co	51
Morton Mfg. Co	95
Motch & Merryweather Machinery Co	102
Mueller Mach. Too Co	71
Mummert, Wolf & Dixon Co	95
National-Acme Mfg. Co	106
National File and Tool Co	69
National Machinery Co	76
Newark Gear Cutting Machine Co	78
New Britain Machine Co	67
New Haven Mfg. Co	68
New Process Raw Hide Co	79
Newton Machine Tool Wks	11
Nicholls, Wm. S	88
Nicholson & Co., W. H	74
Nicholson File Co	17
Niles-Bement-Pond Co.,	35, 36, 37, 38 and 103
Northern Electrical Mfg. Co	92
Northern Engineering Works	88
Norton Co	61
Norton Grinding Co	60
Nuttall Co., R. D	78
Obermayer Co., S	101
O. K. Tool Holder Co	95
Owen Mach. Tool Co	22
Page-Storms Drop Forge Co	95
Parker Co., Chas	91
Pawling & Harnischfeger	88
Paxson Co., J. W	86
Philadelphia Gear Works	78
Picrome Hide Co	78
Potter & Johnston Mach. Co.,	20 and 21
Powell Tool Co	75
Pratt Chuck Co	81
Pratt & Whitney Co	2 and 3
Prentice Bros. Co	29
Prentiss Tool & Supply Co	102
Q. C. Machine Tool Co	94
Ransom Mfg. Co	91
Reed Co., F. E	49
Reed Mfg. Co	91
Reeves Pulley Co	85
Reichhelm & Co., E. P	74
Reynolds Machine Co	77
Risdon Tool Works	79
Rivett Lathe Mfg. Co	3d cover
Robinson Tool Works	90
Rockford Drilling Machine Co	83
Rockwell Furnace Co	86
Rockwood Mfg. Co	89
Rogers & Hubbard Co	85
Rogers Wks., John M	72
Root Co., C. J	77
Roth Bros. & Co	93
Royersford Fdry. & Mach. Co	70
Russell Anti-Friction Drill Chuck Co	82
Safety Emery Wheel Co	90
Sanford Mfg. Co., F. C	87
Saunders Sons, D	72
Sawyer Gear Works	78
Schaeffer Machine Works	95
Schieren Co., Chas. A	74
Schuchardt & Schutte	74
Schumacher & Boye	9
Schwerdtle Stamp Co	76
Screw Machine Products Corp	72
Sebastian Lathe Co	32
Sellers & Co., Inc., Wm	30
Seneca Falls Mfg. Co	68 and 104
Shepard Electric Crane and Hoist Co	88
Shultz Belting Co	76
Sibley Mch. Tool Co	71
Simonds Mfg. Co	70
Skinner Chuck Co	80
Slate Machine Co., Dwight	73
Sloan & Chace Mfg. Co., Ltd	51
Slocomb Co., J. T	67
Smith Countershaft Co	97
Smith & Mills	104
Smith Co., Wm. J	96
Spacke Mach. Co., F. W	87
Springfield Mach. Tool Co	15
Standard Connecting Rod Co	69
Standard Engineering Works	76
Standard Gauge Steel Co	86
Standard Tool Co	68
Stark Tool Co	104
Starrett Co., L. S	97
Stearns Stamping Co., W. H	95
Stoever Fdry. & Mfg. Co	77
Sturtevant Co., B. F	16
Tabor Mfg. Co	65
Taylor & Fenn Co	82
Taylor-Wilson Mfg. Co	78
Toomey, Frank	104
Triumph Electric Co	94
Tudor Mfg. Co	95
Underwood & Co., H. B	77
Union Mfg. Co	80
Union Twist Drill Co	53
Universal Fluxine Co	86
Universal Machine Screw Co	69
U. S. Electrical Tool Co	94
Van Dorn & Dutton Co	79
Van Dorn Elec. & Mfg. Co	94
Vandyck Churchill Co	32
Veeder Mfg. Co	95
Vitrified Wheel Co	90
Von Wyck Mach. Tool Co	70
Walcott & Wood Mach. Tool Co.	76
Wallace Supply Co	79
Waltham Machine Works	82
Waltham Watch Tool Co	100
Walton Co., The	101
Ward & Sons, Edgar T	85
Warner & Swasey Co	31
Warner Instrument Co	72
Waterbury Farrel Fdry. & Mach. Co	74
Watson-Stillman Co	89
Western Electric Co	92
West Haven Mfg. Co	82
Westinghouse Electric Mfg. Co	93
Westmacott Gas Furnace Co	85
Whitcomb-Blaisdell Machine Tool Co	19
Whitman & Barnes Mfg. Co	63
Whitney Mfg. Co	45
Whiton Machine Co., D. E	80
Wiley & Russell Mfg. Co	73
Williams & Co., J. H	66
Wilmarth & Morman Co	90
Windsor Machine Co	26
Winkley Co	73
Woburn Gear Works	79
Woodward & Powell Planer Co	66
Worcester Machine Screw Co	77
Wormer Machinery Co., C. C	104
Wrigley & Co., Thos	90
Yale & Towne Mfg. Co	88